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Editor

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Two Decades of "Engineering Literature"

TWENTY years or 240 monthly issues of the "Engineering Literature" section are concluded with the present issue. The first fifteen years of the section was reviewed at length in the issue of Nov. 15, 1917, p. 934. Included in that review was a reprint of the statement of the scope and aims of the section as printed in the initial number. Both scope and aim remain the same: To chronicle and characterize books and other publications in the field of civil engineering as they appear, treating them as news and, where demanded, with constructive criticism.

Excess Mixing Water Made Obvious

EXCESS water in concrete is now accepted generally as a source of weakness but few users of concrete appreciate how much of the water apparently necessary to make a workable mix is actually superfluous. Visual evidence of this superfluity is offered in the manufacture of the centrifugal concrete pipe described on another page. It is really remarkable to see how much water can be squeezed out of a mortar which is by no means sloppy but is in fact drier and more mushy than much of the concrete that is being placed today. Unfortunately the centrifugal process, or any pressure process indeed, is not practicable for any but precast pieces, so the extremely dense and strong concrete formed by thus expelling needless water can hardly be expected in structural work but the lesson so graphically taught in making these pipes can be taken to heart and possibly applied in some other form to the greater complications of cast-in-place concrete.

Traffic Officers on Roads

TRAFFIC control by semaphores and by officers is an obvious necessity in the crowded city street but the importance of such control on the country road is only beginning to be recognized. Many roads now carry traffic of a density surpassed only by the most busy of city streets and the problems of safety and congestion which arise call for constant supervision, not only to put a stop to much of the abuse of the road, but also to improve general traffic situations in such a way as to make possible its more effective use during periods of unusually heavy traffic. Unrestrained impatience on the part of a few motorists during holiday rushes can start traffic jams that create prolonged blockades. Recently such a jam involved 1,500 or 2,000 automobiles and extended for more than a mile along a well-paved California highway, and held up individual cars more than an hour. With adequate policing that same highway has carried larger volumes of traffic without delay, which emphasizes the sometimes forgotten fact that well controlled traffic will operate effectively over a roadway on which a much smaller volume unregulated will choke itself. The highway engineer, who now deals in transportation, has a responsibility in seeing that the road is properly used, but beyond that there is an economic consideration which affects first costs. The present-day tendency is unmistakably toward wider pavement, but there is a limit beyond which it cannot go. On roads of reasonable width adequate policing, particularly during special heavy traffic, will forestall the premature demand for widening the pavement.

Against Public Expenditure

ELECTION results last week were everywhere so one-sided that there could be no question of the temper of the people. Because of this obvious running together of many minds it is significant that so far as the returns are now available votes for all measures which involved the direct appropriation of public funds, with the exception of those for the building of schools, dropped far behind the vote for the winning ticket, which represents the general trend of the voters' thought. In some states, as in the case of the California hydro-electric state ownership amendment, the vote was definitely against adoption; in others, as in the New Jersey highway bond issue, the favorable vote fell far below that cast for the winning ticket but still remained sufficient to insure passage by a small margin. This result can hardly be called surprising; it is the natural reaction from the spending era of the war and the post-war inflation. The people want economy in public affairs and the most elementary and obvious way to start to be economical is not to spend. Arguments that expenditure now may save future greater expenditures fall on deaf ears when the tax rate keeps mounting. In the highway field the resentment against expenditure lies deeper and constitutes a real danger to the proper development of the roads of the country. So serious is this situation that next week *Engineering News-Record* will discuss it in detail, with some suggestions for a program to combat a tendency which may put us in back years in our highway development.

Tax the Highway Sign

ON THE ground that advertising signs along highways are conducive to accidents, an Oregon highway engineer has recently ordered the removal of all such signs that trespass on the highways. This is one more addition to the long list of protests against a public highway nuisance. Many states do not allow such signs on highway right-of-way but, so far as we know, Massachusetts is the only state that attempts to control them on private property along the highways, and even there the cities and towns have superior powers over the road signs inside their boundaries. The glaring signboard close to the highway, challenging every motorist who passes, besides being an accident menace is an imposition on the traveling public and an offense to every lover of nature. Because the owner of private property has been paid for the privilege, a bill posting company assumes the right to reap a benefit—and that

in an objectionable way—from the public highway toward which it pays nothing. The advertising value of the sign depends on the highway owned by the public, and not on the private property whereon it stands. Therefore the first obligation of the bill posting company is to the public. Permission from the land owner is a secondary consideration—another matter altogether. As now tolerated, the billboard is a parasite on the taxpayer who pays for the highways. He is, generally speaking, offended by the nuisance as much as any one else and the great wonder is that he has so long endured the imposition. Highway engineers have done well to exclude advertising signs from the right-of-way. It is now time to go one step further and urge that each state legislature pass a law extending the Massachusetts idea of control so that at least there will be some governmental supervision of the character and location of signs. Those which can not be excluded should be made to pay a proper tax.

By the Lamp of Experience

SEVERAL months ago we commented on the effort of the French government to turn over its state railways to private operation. Now we learn from the news dispatches that a commission appointed last spring by the Chamber of Deputies has recommended similar action with the telephone system. It appears that during the last two years the telephone administration has sought to lighten its burdens by the simple expedient of discouraging applications for telephones, and for this purpose it has imposed an extra charge of 700 francs per year. M. Lambert, head of the commission, is quoted to the effect that France must base her telephone system on the commercial spirit or it never will be any good, and he recommends private operation under government supervision. In Italy, too, the new Premier is planning to transfer the telephones, telegraph and railways to private ownership, and we are told that the government already has begun negotiations for turning over the telephone system to a private company of Milan. This trend toward private operation at a time when the nations are trying so desperately to develop their highest efficiency is an illuminating commentary on the relative worth of public and private managements.

Making Both Ends Alike

AFTER a recent visit to half-a-dozen of the great ports of northern Europe, B. F. Cresson, Jr., chief engineer of the Port of New York Authority, comes home with the suggestion that there must be international co-operation in the design of ports, particularly in respect to the material-handling machinery. It is little short of absurd, he thinks, that the two termini of the transatlantic ferry should be radically different in equipment and in routine of loading and unloading. He therefore proposes some sort of international association of port authorities who could get together to meet each other's mind even if complete similarity of port design could not be developed. With due acceptance of the inevitable differences in port layout and in the local transportation and labor conditions some greater degree of uniformity in freight handling could certainly be brought about by such an association. It need not aim at standardization but it could harmonize methods and equipment so that a more rapid turnaround would result at both sides of the Atlantic.

A Modern Porous Foundation Dam

ONE of the first requirements for a dam is a solid foundation, for in spite of—though it may be because of—the theory of dam design which guards against shearing, slipping and overturning as major dangers, the records show that most dam failures are due to percolation under the dam and consequent partial removal of the sub-foundation ground. Nevertheless sometimes dams have to be built where there is no solid bottom and then a technique of design is used quite different from that which governs the normal dam on good rock. The base is spread so far up and downstream that the structure may be truly said to float on the weak subsoil and by great length of base and by cutoff walls the undercurrent of water is led through so long a path as to remove its destructive force. Such dams were common in the primitive irrigation of India and the principles learned there have been extended to numerous modern structures in that birthplace of irrigation, but only a few have been built in this country. The one built by the Indian Service across the Gila River, described elsewhere in this issue, is therefore eminently worth recording, not because it shows any new principles but because it illustrates the adaptation of the porous foundation dam to the materials and engineering ability available today.

Regulation of City-Owned Utilities

THE wide extent to which privately-owned municipal water-works have been put under state control while those owned by the cities have generally been left scot free, except as regards the sanitation of water, has led a subscriber to suggest a "campaign looking to the financial control by state utility commissions over municipally-owned and operated water-works" in order to promote "business" rather than "political" administration. It is significant that the suggestion comes from a man who for years has held a responsible position in the administration of a municipally-owned water-works. Wisconsin is a notable instance of state control of some phases of the financial administration of city-owned water-works. Apparently the plan has been beneficial in that state. The extension of the plan might well be given attention, now that most of the legislatures will soon have their biennial session. Strong objection may be expected from the "home rulers," of whom there are many. The extremists in this class object even to state control of privately-owned utilities, claiming that the cities themselves, untrammelled, should do all the regulation. The argument in favor of a reasonable degree of state control of municipally-owned water-works is stronger than that against.

Higher Municipal Bond Interest

ALTHOUGH still considerably lower than in the earlier post-war days the interest rate on municipal bonds has risen of late. Combined with a like advance in labor and material prices this tends to discourage municipal enterprises but there is some offset in improved industrial conditions. Moreover, the lag in municipal construction for several years past is a constant urge for water, sewer, paving and other improvements. Sound judgment in the planning, adoption and execution of municipal work is more necessary than at any time since the war, but with such judgment assured there should be no recurrence to a holdup of needed improvements.

Studies in Engineering Economics

WHEN we think of great engineering enterprises as depending on the solution of difficult technical problems of design and execution, we are apt to overlook the equally vital economic problems involved. The justification of every major piece of civil engineering construction lies in the fact that it yields large return on its cost, and in nearly all cases this return must be demonstrated before construction can begin. Such advance calculation of results contains formidable economic problems. If they are looked upon with less respect than they deserve, it is because superficial methods of solution have usually been thought sufficient. When painstaking study is applied and a precise and dependable result is sought, the dominant importance of the economic phase appears clearly.

A remarkable instance is presented in the appraisal work of the Miami Conservancy District, described for the first time in this issue. The great flood-protection enterprise called into being by the disaster of 1913 could not enter on its first step toward realization until a scrupulously precise reckoning had been made of what it would ultimately accomplish, not merely for the region as a whole but for every parcel of property contained. Unless this appraisal had been made and had been found absolutely fair, there would be no completed flood-protection system in the Miami Valley today. The engineers and appraisers who carried it through accomplished the most difficult task of the whole period of struggle since 1913. Their success exemplifies strikingly both the possibility and the difficulties of computing results before construction; and at the same time it gives an emphasis to the broad economics of engineering planning that has long been needed.

It is to be remembered in connection with the Miami benefit appraisal that the questions of fact and logic which it involved were only one element of the problem in hand; and by no means the largest. The dominant one was the human element. The entire population of the extensive valley district was involved. The citizens and farmers, owners of 70,000 individual properties, were to be called upon for a huge sum of money, $30,000,000 or more, and such demands mean strong protest and opposition. The people had to be awakened to sympathy and support, and all antagonisms eliminated. The advantage which the project would bring to the district had to be computed so convincingly that it would assure the approval not merely of the court but also of the great majority of those who would have to pay; and at the same time it had to be sound and practical enough to overcome the arguments of the few who remained unconvinced. It was necessary, finally, that the distribution of the aggregate benefit among the different parcels of land should be based on principles clear and definite enough to permit its fairness to be demonstrated almost mathematically. Unerring judgment of physical conditions and equally unerring judgment of the action of the human mind had to be combined in working out the solution of this tangled problem.

Such appraisal of returns from an engineering enterprise is possible, we learn from the Miami record, even in the face of exceptional difficulties. This is a worthwhile lesson. Many a promising project lies idle today that could proceed at once, were the benefits to be derived from the completed work demonstrated. The same condition will always exist. There will always be boundless opportunity for careful forecasting of the benefits of public-service improvements. The Miami work is a heartening stimulus and its methods furnish a precedent and model for such studies.

The special importance of benefit appraisal in flood protection is worth a separate word. Floods menace innumerable valleys throughout the country and are responsible for huge annual losses. But for any one valley the danger and the loss are speculative rather than present, while the cost of protection is a real and onerous burden, and under these circumstances it is not easy to overcome the inertia of a large population and induce it to undertake the construction of protective works. Only by a penetrating analysis of flood risks and flood damages can the necessary conviction be produced; and, as some actual cases have shown, even this work will fail if the allocation of flood damages—or flood-protection benefits—is not made with such refined fairness that the final project can justify itself in every detail as well as in the whole. In the future flood-protective science, whose development lies not far ahead, the details of economic analysis will have a leading place.

Theory and Practice

IN CONSIDERING the unusually interesting theoretical study of the strength of various rivet arrangements printed in this issue, the engineer will find it advisable to keep in mind rather carefully the bearing of theory and practice on the problem in hand. It happens that proper rivet grouping is one of the very fundamentals of structural design, as it is also of boiler construction; but, while mechanical engineers may have succeeded in dealing with their riveted seams in perfectly satisfactory manner—which, in the lawyer's parlance, not knowing we deny—civil engineers can not claim as much for the riveted connections used in structures. Certain elements of the problem make it quite appropriate to enter into a careful mathematical study of proportioning even though the method seems to go far beyond the available empirical knowledge. Mr. Cochrane has gone into such a study, with quite illuminating results. It will be recalled that the past year has brought out a considerable amount of discussion of the same problem, the effective net area of a built-up tension member. The present article may be considered as a concluding contribution. The entire discussion has helped to clarify the problem; but as to practical procedure, or a desirable specification rule, engineering judgment is likely to refer back to the fact that the strength of built-up tension members is one of the least known subjects, so far as large size experimental study is concerned. Until such study furnishes a basis for quantitative thinking on rivet arrangement, two important considerations are that there is unquestionably a non-uniform distribution of stress in the spaces between rivet holes, which reduces the effective resistence of the member, and that the rivet holes probably weaken the metal in other ways than by mere reduction of cross-section.

These points suggest caution in applying refined calculations to rivet grouping, unless there is an ample margin of safety to allow for error in the basic assumptions. Further, on the view that small staggers are undesirable and should be discouraged by a conservatively framed specification, it is likely that most bridge engineers would rather put a penalty on deficient stagger than to seek a meticulously accurate measure of the proper rivet deduction for each stagger ratio.

Floating Concrete Dam Built on the Gila River

Porous Foundations Require Spread Footings for Low Diversion Dam—Built by Indian Service Under Force Account—Special Construction Details To Avoid Floods

Compiled from the field and progress notes of Maj. C. R. Olberg, Ass't Chief Engineer, U. S. Indian Service, who had charge of the work.

By C. J. Blanchard
Statistician, U. S. Reclamation Service, Washington, D. C.

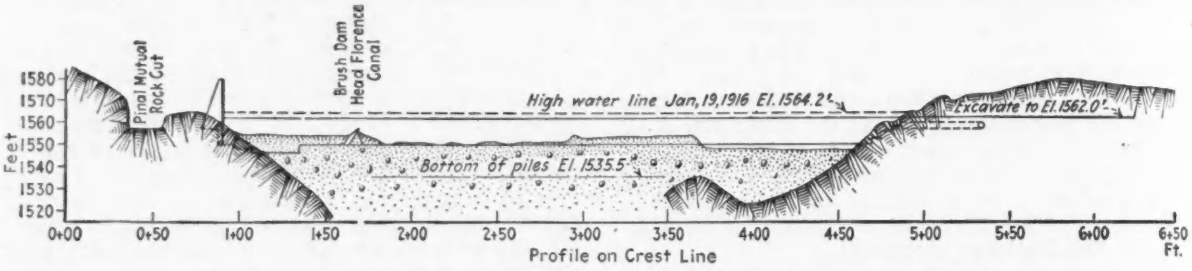
POROUS foundation dams of the floating weir type so common in India have not been built in great numbers in this country. This description of a notable one, across the Gila River near Florence, Ariz., is offered as an example of the design and methods of construction of this kind of structure. It was built as a diversion dam for an irrigation canal by the U. S. Indian Service by force account.

The dam is located about 12 miles above Florence at a point where the Gila River passes through a low granite ridge which is a part of the range cut by the lower Gila Canyon, the mouth of which is a few miles above the dam site. At the dam site the channel is about 400 ft. in width with rock walls rising about 30 ft. high on each side. Borings at this point disclosed the fact that the river bed is really a filled in canyon, the rock on both sides of the river extending only a short distance into the channel and then dropping off vertically more than 100 ft. It being impracticable under these conditions to construct a dam on bedrock, the weir type of floating dam was selected.

The Florence Dam consists of a floating slab of concrete 396 ft. in length, 212 ft. in width and varying from 2 to 5 ft. in thickness. It is keyed to the rock on both sides of the river and supports a hollow weir or dam, 10 ft. in height of the same length as the slab. In order to provide greater spillway capacity the crest of the dam is extended into the rock forming the north bank, a distance of 120 ft. The total width of freeway for the passage of water from the wall of the intake gates on the south bank to the face of the upper rock cut on the north bank is 515 ft. Additional width on the north bank could not be secured without trespassing on the right-of-way of the Arizona Eastern Ry. which parallels the river opposite the dam.

The weir is keyed into the face of the lower rock cut on the north and on the south a retaining wall protecting the intake gates forms the abutment. A sluiceway provided with suitable guide walls is located in the weir immediately in front of the intake gates. The intake works include a bank of nine regulator gates which divert water into the intake of the Casa Grande Canal 40 ft. wide on the bottom, 6 ft. deep and with a capacity of 1,000 sec.-ft. Like the spillway on the north bank the upper section of the canal, including the forebay behind the intake works, is blasted out of the solid rock.

The dam and headworks are designed to pass a maximum flood of 150,000 sec.-ft. With such a flood there will be a depth of 17 ft. of water over the crest, the elevation of which is 1,562 ft. above sea level. This depth required that the curtain wall in front of the intake gates should be brought up to El. 1,580 to avoid drowning the canal during high water. Additional freeboard is provided by a solid parapet wall over the gates, 3 ft. in height. The dimensions and relative location of the component parts of the slab and dam are shown in the accompanying plan and section.



CROSS-SECTION THROUGH FLORENCE DAM SITE SHOWING POROUS BOTTOM

The slab is divided into four sections: The rear apron, main slab, fore apron or upper talus and the lower talus.

The rear apron is 16 ft. in width and 12 in. thick; reinforced through its length with ⅝-in. bars spaced 28 in. on centers. A 9-in. concrete cutoff wall 3 ft. in depth, also reinforced, protects the heel or upper edge of the apron.

The main slab is 56 ft. wide and varies from 2 ft. in thickness at the lower edge to 5 ft. at the upper. It is not reinforced but is provided with expansion joints every 40 ft. Specifications for the concrete in the slab called for 1:3:6 mix with 35 per cent plums. The slab rests on two rows of Wakefield sheet piles composed of three 2x12's bolted together driven to a depth of 16 ft. below the bottom of the slab.

The upper talus is 70 ft. in width and 2 ft. thick and is composed of 1:3:6 concrete with 60 per cent plums. It is reinforced with ¼-in. steel bars spaced 2 ft. on centers both ways. The lower edge is protected by a cutoff wall, similar to the one under the fore apron. There is a drop of 18 in. between the surface of the upper and lower talus.

The lower talus is also 70 ft. wide and 2 ft. thick, the lower 40 ft. constituting the so-called "articulated section," which is divided into blocks 10 ft. square, tied together with iron rods. These blocks are intended to settle so as to conform to the bed of the river if

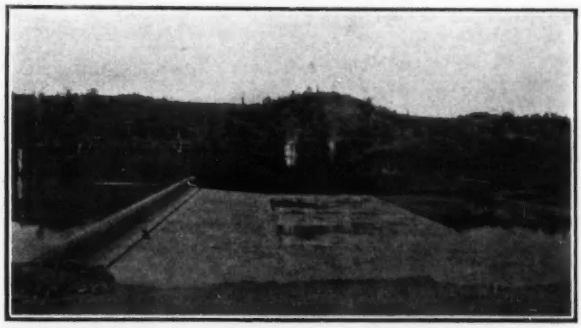
erosion should occur under flood action. The lower talus is reinforced like the upper and the composition of the upper 30 ft. is identical with it. Specifications for the articulated section called for 1:3:6 concrete, ¾-in. crushed rock and 60 per cent plums. A talus of large rock was laid below the articulated section as an additional protection for the dam. The rock was laid as the river scoured out the sand and gravel and varies from 5 to 20 ft. deep and from 20 to 50 ft. wide.

The ogee weir on the fore apron is thoroughly reinforced in both directions with steel bars and anchored to the slab. It includes a 42-in. cement pipe intended to carry water from the intake gates across the river to a small canal on the north bank. The weir was poured in 40-ft. sections conforming to the expansion joints in the main slab. The cement pipe was provided with copper collar or coupling at each joint designed to take up the expansion and prevent leakage. Specifications for the weir called for 1:3:6 concrete and 2½-in. crushed rock. River gravel, however, was substituted for the rock as it reduced expense.

The sluiceway is located immediately in front of the intake gates so the sand and silt can be sluiced out before entering canal. Openings through the dam are provided with four 4x8-ft. gates of the rising type separated by reinforced-concrete piers 3 ft. thick while the sluicing channels leading to the gates are formed by thin reinforced-concrete walls of appropriate height, shape and direction to assist in sluicing action.

A bank of nine 4x8-ft. regular gates of the folding or leaf type is provided for the heading of the main canal, so that water may be skimmed from the surface of the river to prevent rolling sand and silt from entering the canal. The elevation of the gate sills is 4 ft. above the crest of the dam and 3 ft. above the bottom of the canal.

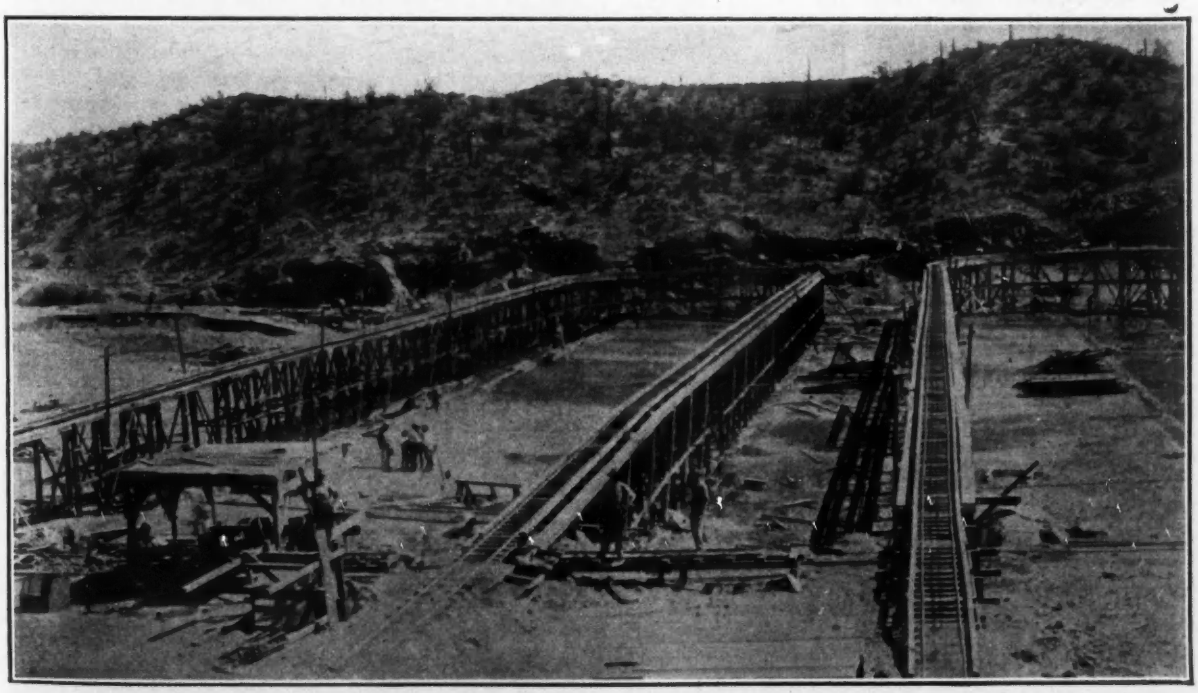
Reinforced-concrete piers 2 ft. 6 in. thick resting on bedrock separate the gates. These piers are 25 ft. high and 20 ft. wide. The face of the intake is formed



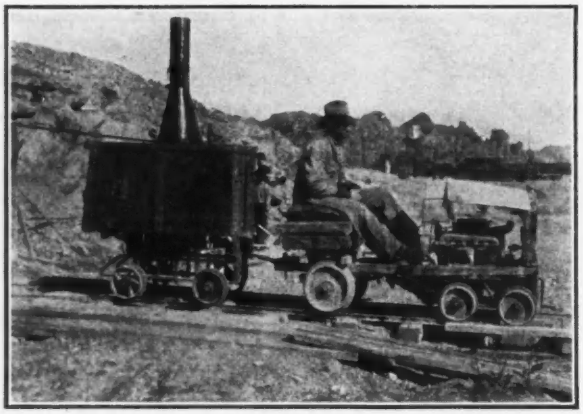
LOOKING ACROSS THE COMPLETED DAM TOWARD THE HEADWORKS

by a reinforced curtain wall 18 in. thick extending from the top of the gates to a point above high water. An operating deck supporting the machinery for raising the gates is located between the piers and 8½ ft. above the canal bed. These piers and deck are heavily reinforced and composed of 1:7 concrete, using river gravel. Gates and frames for both sluiceways and intake are of cast iron. Both sets of gates are operated with hydraulic power, the operating machinery consisting of a pressure tank and heavy-duty pump driven by an electric motor, and are located in a small room under the road and adjoining the first or downstream bay of the regulator gates. Pipes lead from the tank to the cylinder operating the gate, the gate being raised or lowered by simply turning a valve. Power for operating the force pump is supplied by a small 15-hp. gas engine and 7.5 kw. d.c. generator. Clear water for the cylinders is obtained from a well in the rock under the spillway section.

The regulator gates are protected from the river on the upper or east side, by a concrete retaining wall joining the curtain wall in front of the gates to the rock bluff behind the intake. Since the curtain wall



ELLIPSE SHAPED TRESTLES FOR CONCRETING FLORENCE DAM



TRANSPORTING CONCRETE TO THE DAM
Note automobile engine mounted to make locomotive; also crusher jaws to add weight for traction.

is extended back, it acts as a retaining wall to round out the forebay to the canal. The space between the two walls is filled in with waste from the quarry. These upper retaining walls, like those below the gates, are composed of 1:8 concrete, using 2-in. river gravel, with 10 per cent plums. The downstream side of the gate intake is protected by the retaining wall forming the south abutment of the dam. This wall is surmounted by a paved slope, protecting the earth fill, which slopes from the top of the curtain wall in front of the gates to the level of the canal bank to avoid excessive rock excavation or a contraction of the river channel. To secure the necessary width for an inclined slope, the canal face of the fill is protected with a retaining wall. This wall, like the one against the river, slopes from the top of the curtain wall to the canal bank. The surface of the fill between the walls is utilized for a road. This road passes along the canal bank, over the canal, and over the gates making accessible not only the small power plant and dam tender's cottage located on top of the bluff back of the intake gates, but also some of the most interesting scenery in America.

Construction of the Dam—The Gila Valley is usually subject to two rainy seasons a year, one occurring between November and March, which generally occasions a continuous flow in the river but seldom gives rise to a large flood; the other extending from July 1 to Sept. 1 is due to violent local disturbances which often cause extreme high water.

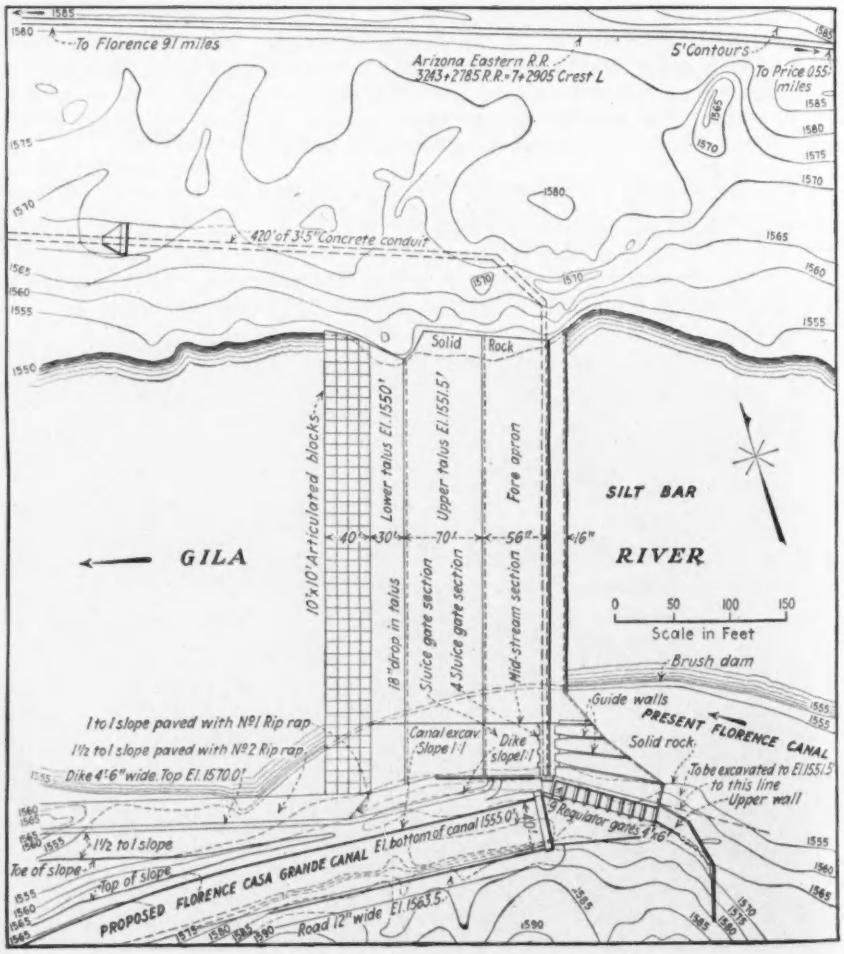
Under these conditions it was essential that the slab, which in case of high water would be subject to almost certain destruction if but partially completed, should be finished before the first of July.

Since instructions to commence the work did not reach the employees of the Indian Service until the latter part of January, there were only five months in which to make the necessary preparations and install the slab. Owing to the risks attending the work reasonable bids were not obtainable and force account was decided upon. The task was rendered rather trying owing to scarcity of construction equipment and materials, poor transportation, high-priced and limited labor.

The work required for the completion of the dam comprised 25,000 cu.yd. of rock excavation, 82,570 cu.yd. of earth excavation and 12,933 cu.yd. of concrete.

The construction problems demanding immediate solution included excavation for practically the entire work, the driving of the sheetpiling and the pouring of 8,480 cu.yd. of concrete, forming the main slab and talus of the dam, over an area some 400 ft. in length by 212 ft. in width. The work had to be done in the bed of a sandy river, always subject to flood, and completed before July 1 to prevent its almost certain destruction.

Construction Plans—The rock excavation promised to give little trouble since it could be commenced almost at once and the work was not subject to the vagaries of the Gila river.



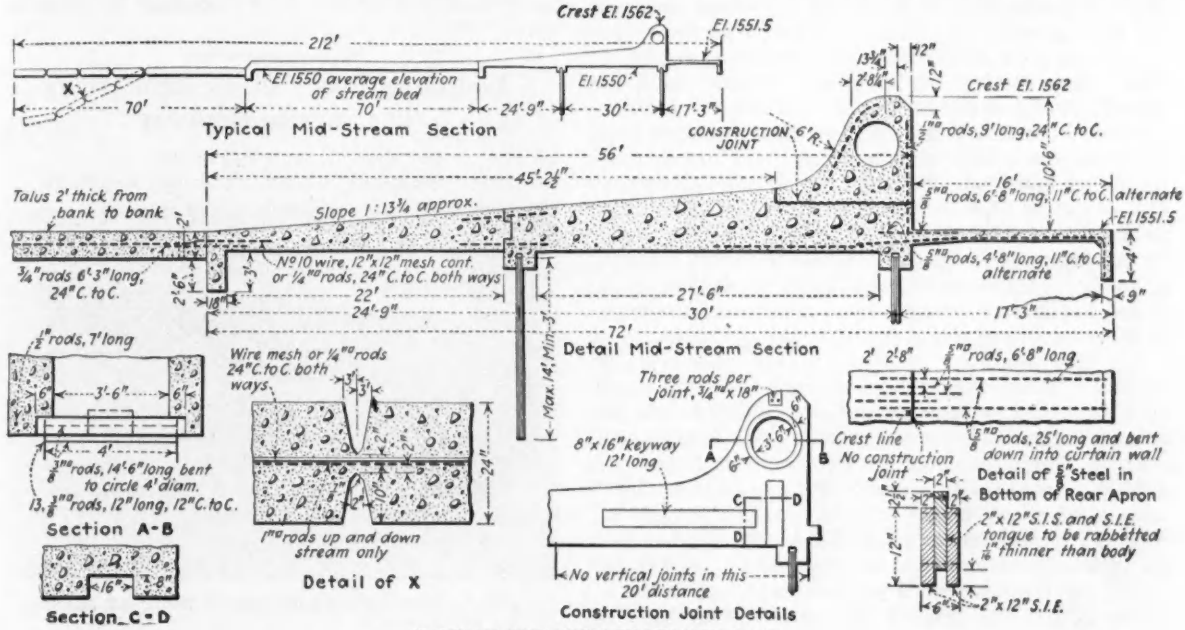
PLAN OF THE FLOATING DAM ACROSS GILA RIVER

The pile-driving and the pouring of the slab had to take place in the bed of the river, and had to be done at the time of least danger from flood, since the river channel at the dam site was too narrow to attempt any diversion or flood protection, even if the expense were permissible. Little difficulty was anticipated in the actual driving of the piles, aside from the danger from high water, since the borings at the dam site revealed only sand and gravel in the bed of the river. To escape high water due to the spring rains it was decided to defer the pile-driving and excavation for the foundation of the dam until about May 1. It was also deemed unsafe to commence pouring the slab much before June 1, and since it had to be completed by July 1, it was evident that the pouring of the slab would call for the maximum effort, requiring a large force of men, and during that time it would probably be necessary to work three shifts. With the exception of the crest, which it was hoped could be poured with the slab, the balance of the work promised to give no greater trouble than is usually incident to work along rivers.

It was finally decided that the only system that at all promised to satisfy the requirements of speed, flexibility and cost, was a set of tramways supporting a narrow-gage track over which small concrete cars could be operated. It is true that the bents of the tramway were subject to destructive flood action but it was considered that they were comparatively inexpensive and that in case of a flood much of the material could be salvaged and the only loss would be that of reconstruction. It was hoped, however, that the work would be completed before the danger from high water became imminent.

The securing of an efficient and rapid means of operating the cars proved a puzzle. A cable system was devised, considered and abandoned as being too expensive and subject to loss from flood. The puzzle was solved by the decision to use small gasoline locomotives but since locomotives of the type suitable for the work could only be obtained in the east at a cost of between $3,000 and $4,000 each, and required three or four months for delivery, they were out of the question and it was decided to attempt the manufacture of locomotives using Ford motors. With this equipment, employing five motors and 2¾-yd. concrete mixers, it seemed possible if necessary to pour the slab in 12 days running full time. This would require a maximum force, for all purposes, of about 600 men divided into three shifts.

As shown in the large view two pairs of trestles joined at each end roughly in the shape of an ellipse or oval were erected across the river with a concrete mixer located at the end of each oval. The trestles supported a narrow-gage track on which ran the locomotives hauling the dump cars. The cars passed under the mixer spouts to receive their loads and then were run out on the trestle to dump the concrete into hoppers discharging into chutes through which the material was delivered to any part of the slab. The trestle legs were set in 12-in. cement pipe so that the structure could be removed, and the holes filled up without breaking the slab. At first the locomotives proved too light for adequate traction. The fault was overcome by weighting the engines with worn-out crusher jaws. The little cars made a round trip in less than 6 minutes and with two trains operating on each trestle the mixers worked up to maximum capacity of ¾ yd. every three minutes.


Crest El. 1562
El. 1551.5
212'
El. 1550 average elevation of stream bed
El. 1550
70'
70'
24'-9"
30'
17'-3"
Typical Mid-Stream Section
56'
45'-2½"
Talus 2' thick from bank to bank
Slope 1:13¾ approx.
No 10 wire, 12"x12" mesh cont. or ¼" rods, 24" C. to C. both ways
¾" rods 6'-3" long, 24" C. to C.
22'
24'-9"
27'-6"
30'
72'
Detail Mid-Stream Section
CONSTRUCTION JOINT 6" R.
16'
⅝" rods, 6'-8" long, 11" C. to C. alternate
⅝" rods, 4'-8" long, 11" C. to C. alternate
Crest El. 1562
El. 1551.5
1" rods, 9' long, 24" C. to C.
Max. 14' Min. 3'
Three rods per joint, ¾" x 18"
8" x 16" keyway 12' long
Crest line No construction Joint
No vertical joints in this 20' distance
Construction Joint Details
⅝" rods, 6'-8" long
⅝" rods, 25' long and bent down into curtain wall
Detail of ⅝" Steel in Bottom of Rear Apron
2" x 12" S.I.S. and S.I.E. tongue to be rabbetted ⅛" thinner than body
2" x 12" S.I.E.
1" rods, 7' long
3'-6"
4'
⅝" rods, 14'-6" long bent to circle 4' diam.
13, ⅞" rods, 12" long, 12" C. to C.
Section A-B
Wire mesh or ¼" rods 24" C. to C. both ways
1" rods up and down stream only
Detail of X
Section C-D

SECTION THROUGH FLORENCE DAM

With the completion of the two sections of talus, work was again started from the north bank of the river on both the articulated talus and the main slab. Two days were spent in forming the ends of the main slab, where it joined the rock making in effect an expansion joint so the slab would not rest both on solid rock and sand and provide an opportunity for the slab to crack if any settlement should occur. This joint was so devised as to prevent slippage, if there should be any tendency for it to happen.

The forming of the under part of the slab between the blocks of the articulated section was a puzzling problem since any wooden forms would necessarily have to be left in after the concrete was poured. The problem was finally solved by making "dobie" forms for

the lower part of the slab, which would wash out as the articulated section settled.

From the beginning of June, when concrete work started, it was apparent that nature was getting ready for the summer rains. Dark cumulus clouds, that only required proper conditions to produce heavy precipitation, crowned the mountains and obscured the sky to the east. In fact the weather was so threatening that a flood was looked for daily but it was really too early for the summer rains and fortunately the weather held. A flood at that time flowing around the end of the partly poured slab would probably have caused its destruction as well as that of the trestles from which it was poured, and a financial loss of $100,000.

On July 5 at 5 p.m. the flood came and took away the brush diversion dam. Recurring floods retarded the work greatly. On August 1 a heavy flood carrying large masses of brush snapped the trestle legs, tore out the dike protecting the work on the south side, destroyed the forms for the guide walls and the sluiceway section of the weir and washed out the temporary canal along the river bed through which the Florence canal was being bypassed. The total monetary loss, however, did not exceed $7,000. Floods continued at intervals up to August 15. During one of these the scour induced by the whirlpool action of the water caused not only a number of the articulated blocks to fall as anticipated but was so extensive that a sector of the upper part of the lower talus dropped with it. The whirlpool action was due to a number of rock points in the channel. These were blown out and 10,000 cu.yd. of rock from the spillway section was dumped into the holes. This work cost approximately $20,000 and entailed strenuous effort to accomplish it before the damage became serious. Each flooding of the work left a mass of sticky mud which had to be shoveled and washed from the concrete before pouring could be taken up again. It was not until October that the flood stages ceased and the work could proceed uninterruptedly.

The loss of the trestles cut off the south bank of the river from the materials on the north bank and forced the engineers to look for gravel on the south side. A good bank of gravel was located about half a mile below and the proportion of sand and gravel proved about right for a 1:3:5 mixture.

The dam was appropriately dedicated on May 10, 1922, in the presence of a large assemblage of Arizona citizens and many members of the Indian tribes of the valley. The exact costs are not yet available but are known not to have been excessive considering the speed required and the adverse conditions under which the work was done. Including the formwork on the crest the cost of the concrete composing the slab probably will not exceed an average of $13 per yard. The dam itself was completed within the estimate of $250,000, which is below the lowest figure set by any contractor. The intake works forming an integral part of the canal and not properly chargeable against the dam consisted of reinforced concrete requiring much formwork. The cost did not exceed $15 per cubic yard.

More than passing interest attaches to this structure the completion of which brings to an end a controversy over the waters of the Gila which has long disturbed the relations between the Pima Indians and the white farmers of this valley. An amicable agreement has been concluded under which the waters are divided on a basis of 35,000 acres of irrigated land for the Indians and 27,000 acres for the whites. The white farmers will be assessed their pro rata of the cost of the dam and payments will be in twenty annual installments.

The successful completion of the Florence dam reflects great credit upon the efficient organization of the engineering section of the Indian Bureau of which W. M. Reed is chief engineer. He placed his assistant, Major C. R. Olberg, in charge of the work. Associated with Major Olberg was Captain Earl B. Patterson as superintendent of construction. Both were eminently fitted for the task by reason of many years of experience in the Southwest while engaged in similar work under the Reclamation Service. Recognition for most valuable services is due Supervising Engineer Herbert V. Clotts, General Foreman Welsh McGuire, formerly of the Reclamation Service, Boss Carpenter B. Bruce and Master Mechanic Dee Brown.

Lightning Bolt Follows Reinforcing in Concrete Highway

BY CHARLES T. FISHER
State Commission of Highways, Binghamton, N. Y.

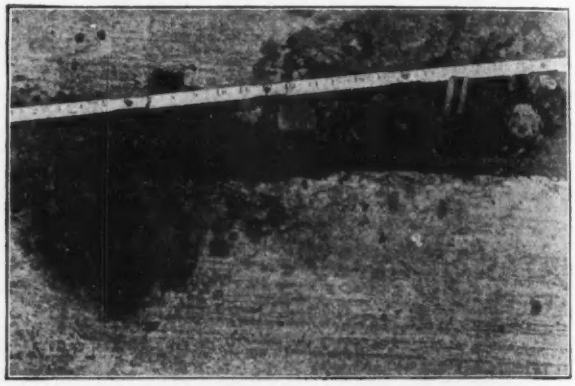


FIG. 1—EFFECT OF LIGHTNING BOLT AT JOINT

AN UNUSUAL case of damage to a highway by the elements occurred during the summer, when a section of reinforced-concrete pavement on a state highway near Sherburne, N. Y., was struck by lightning.

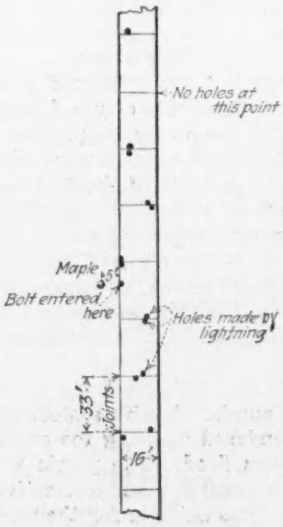


FIG. 2—PATH OF BOLT TRACED BY HOLES

The bolt first struck a maple tree which stood at the side of the road, and then entered the edge of the pavement and traveled along the metal reinforcement for about 100 ft. in both directions. At the point where it jumped from the tree to the pavement a small piece of concrete was broken out of the edge, and at the expansion joints, which are of ⅜-in. bituminous material spaced on 33-ft. centers, holes in the surface about 5 in. in diameter and 3 in. deep were formed on both sides of the joint filler, indicating the path of the current in passing from the metal in one panel to the metal in the next.

Reinforced-Concrete Pipe Made by Centrifugal Process

Pipe Cast With Special Joints Manufactured by Whirling Cylinder Mold on Longitudinal Axis

CENTRIFUGALLY made concrete pipe is now being produced commercially by the Lock Joint Pipe Co. in two plants, one at its home yard at Ampere, N. J., and the other in a specially built yard at Denver, Colo. The former pipe, 20 in. in diameter, is being made for the East Orange, N. J., water-works, the latter 27 in. in diameter for the Greeley, Colo., system. Except for differences in size of pipe and for some minor variations in plant layout, the two plants are alike and the product the same.

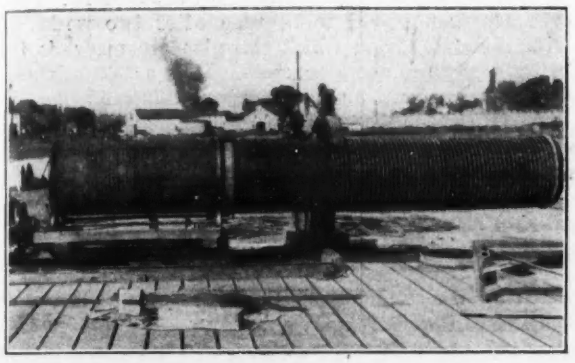


FIG. 1. PLACING REINFORCEMENT IN CAGE FOR 27-IN. CENTRIFUGALLY CAST CONCRETE PIPE

Reinforcement consists of one layer of wire mesh, longitudinal tie-rods hooked into cast-iron end joints and a spiral reinforcing of ¾ in. round rod. Cylinder shown at left is not part of pipe form but the revolving and traveling mandrel on which the reinforcing cage is built up.

Centrifugally cast pipe are made by filling in concrete mortar on the inside of a horizontally placed cylindrical form and whirling that form rapidly on its longitudinal axis, thus throwing the concrete to the inside of the form by the centrifugal force and forming there the shell which makes the pipe. The general idea was used some years ago in Germany in the manufacture of concrete poles, pipes, and piles, and more recently has been developed commercially in Australia and South Africa by the firm of Hume Bros. This latter process was described in *Engineering News-Record*, Oct. 9, 1919, p. 707. The Lock Joint Pipe Co. system has many features of originality, particularly in the casting of a special joint on each pipe whereby the pipe line may be made tight for high pressure.

The first step in the process of manufacture is to make the reinforcement cage to which are tied the metal end joints. These joints are cast-iron rings of the section shown in the accompanying drawing (Fig. 3) which fit bell and spigotwise into one another, the closure being made by the gasket of flattened fiber-filled lead pipe. The bell end of the pipe is forced into the spigot end until the joints come up tight, by a special pressure machine in the trench. This leaves a small V-groove around the outside of the pipe, but no projection, as will be noted from the drawing. The reinforcement consists of two layers of circumferential wire mesh with longitudinal tie rods which fit into slots in the joints and thus hold the whole framework tightly together. In the larger diameters one layer of mesh is supplanted by a spiral rod reinforcement.

A machine, consisting of a mandrel and a guide for the spiral reinforcing, is used in building up of this cage. The machine is shown in the view in Fig. 1. In the production of the pipe at Ampere two men are kept busy making the cages and can take care of the twenty pipe per day production of the plant. From the cage-making platform the cage is carried over to another platform and encased in the outer form, a shell made up of two semi-cylinders of bent plate iron braced with circumferential lugs, with grooves or sheaves for the wire rope which imparts the whirling motion.

The pipe-making machine consists of a concrete mixing plant, a loading platform, and a whirling machine arranged in progressive order and all controlled either by a paralleling track on which is a crane or by overhead track. Concrete is mixed at one end of the plant, carried over and dumped into a charging platform which has side boards that drop down as aprons into the charging buckets, one on either side of the charging platform, each bucket being in longitudinal line with the whirling axis. This charging bucket consists of a longitudinally placed cylinder with a slot a few inches wide along its elements. It is completely filled with the concrete through the slot and then moved longitudinally on tracks into the center of the whirling form. This form, as noted above, is of wrought iron in take-down construction and is set up around the reinforcement

FIG. 2. FINISHING YARD OF CENTRIFUGAL CONCRETE PIPE AT DENVER

Cast-iron joints in foreground; whirling frame out of view at right; on overhead track is being shifted a completed pipe still in its form; finished pipe in the yard.

cage so arranged that the cast-iron joints at the end of the cage are flush with the circumference of the torm. The grooves or sheaves on the form are then engaged by the endless steel cables that hang from frame and give the form its whirling motion.

Once the charging bucket is inside, the form is started to whirl and the charging bucket is slowly turned over, so that it discharges its concrete content

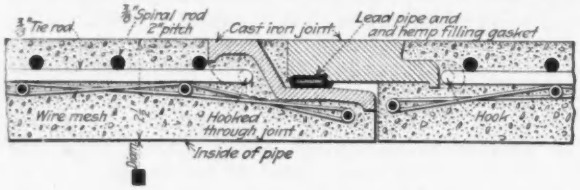


FIG. 3. SECTION THROUGH JOINT AND SHELL OF CENTRIFUGALLY CAST CONCRETE PIPE

uniformly along the inside of the form where it is immediately thrown outward by the centrifugal force, to the inside surface of the form. The size of this charging bucket is so designed as to give the proper concrete content to form a shell of a required thickness. This varies slightly at times and the exact amount is controlled by adding small bucketfuls of concrete by hand inside the forms. The form is speeded up to about 200 revolutions per minute and is allowed to whirl for about five minutes; then there is inserted into the center a pan resting clear of the form at either end and pro-

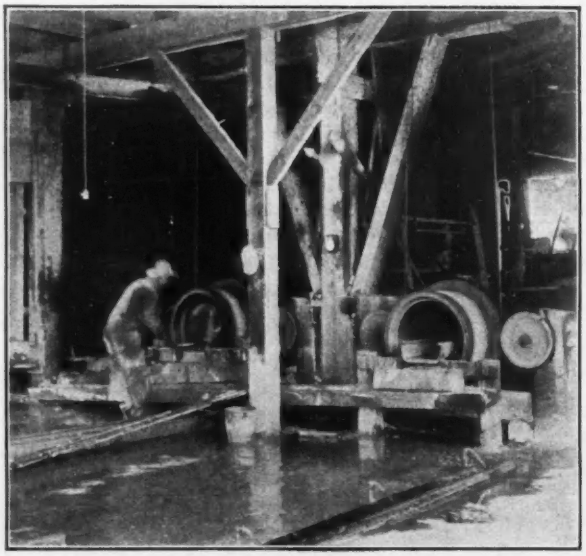


FIG. 4. END OF WHIRLING FRAME

Arranged in duplicate on either side of center line. At right form shows finished pipe with protruding pan into which is drained the excess water, etc., cleaned off pipe by brushes shown at right of man. At left pipe being whirled from cables hung from overhead sheaves.

jecting from the center of the form. It is used as a guide for brushes, manipulated by the attendant, which clean the interior of the pipe and collect the excess water which clings to the whirling surface. These brushes scrape the excess water and laitance from the inside of the pipe. It is surprising to note that in a pipe 20 in. in diameter, 2½ in. shell thickness, and 12 ft. long, with a concrete that would be considered a normal working mortar plasticity, a full wheelbarrow load of cement, colored water and laitance is drawn off.

After the pipe is whirled about 15 min. two or three bucketfuls of neat cement grout are applied by putting in a second pan running on the first interior pan and dumping it, thus distributing the grout content uniformly along the whole pipe. This forms a thickness of about ⅛ in. of cement grout on the inside surface of the pipe. The final operation is to brush this cement surface by the brush running on the pan as a guide and after 20 min. of whirling the machine is stopped and the pipe with its form withdrawn. At that time it has reached a remarkable degree of hardness, so great, indeed, that the forms with the pipe in them could be immediately removed from the machine in a horizontal position without injury. In practice the pipe with the form still on is placed on the platform and is treated in a steam chamber for about 18 hr. The pipes are then stored to be used after two weeks.

The concrete, from which the pipe are made, is in reality a mortar, not a concrete. It is a 1:2 mixture of portland cement and ordinary good, clean building sand, with no special provisions as to grading. The mortar is mixed, as stated above, to a consistency common in bricklaying mortar, but inasmuch as excess water is forced out by the process, no extra pains are taken to insure a proper water content in the mixer.

The finished pipe present a remarkably uniform surface, both inside and out, and when lined up are true to circumference and line. So far no tests have been made as to their strength, but they are being used for pressures up to 50 lb. per square inch for the 20-in pipe, and they have resisted pressures up to 200 lb per sq.in. Both the 27- and the 20-in. pipe have thicknesses of 2½ in. and are made in 12-ft. lengths.

Salaries of State Sanitary Engineers

Publication of the statement that the chiefs of the divisions of sanitary engineering of the state health departments in Maine and New Hampshire were the poorest paid of any of the states, contained in an article entitled "Salaries of State Sanitary Engineers" in *Engineering News-Record*, Oct. 12, 1922, p. 609, has brought forth protests from individuals in these two states. It appears that in Maine sanitary control of public water supplies and sewers is divided between the State Department of Health and the Public Utilities Commission and that the person who does the sanitary engineering work for the former body is not by training and experience an engineer. From New Hampshire comes the statement that the sanitary engineer of the State Board of Health is a subordinate in the division of water supplies, foods and drugs, the chief and state chemist receiving a salary of $3,000. These letters were turned over to James A. Tobey, author of the article, who comments as follows: "The data concerning salaries of personnel of state health departments was compiled from returns to a questionnaire sent out to state health officers by the Committee on Salary Standards of the American Public Health Association, replies having been received in January, 1922. It may be using a misnomer to apply the title of sanitary engineer to the individuals who do the sanitary engineering work for the state health departments of Maine and New Hampshire. It is a fact, nevertheless, that in each of these state health departments there is a person who is called a sanitary engineer by the state health officer, and that in each instance he receives a salary of $1,800 a year."

Appraisal of Flood Protection Benefits and Damages in the Miami Valley

Increase in Value from Protective Works Estimated on Basis of Flood-Time Depreciation—Equitable Distribution and "Flooding Factors"—Farm and Utility Benefits

CONSTRUCTION of the flood-control works of the Miami Conservancy District in Ohio was financed by means of special assessment bonds issued by the district. Under the Conservancy Act of Ohio the assessments authorizing the issue of these bonds constitute a lien against each property benefited, up to the amount of benefits assessed against the property. This lien is paramount to any other except that of the general taxes for state, county and city purposes. It was therefore of primary importance to make careful determinations with reference to each tract or property as to just how much it is benefited.

Benefit Appraisal—In the case of most land reclamation, drainage or improvement projects it is possible to make a reasonably accurate estimate as to the value of the land after its improvement, and the difference between this new value and the original value gives the amount of the benefit. In the case of the Miami flood-control project, however, the benefit accruing to properties in the cities of the valley could not be determined so simply. Real estate values were considerably disturbed by the 1913 flood, in fact some values were completely destroyed. Street pavements were torn up, and light, water and sewer systems damaged. Residences and other private property were destroyed or damaged and railways and telephone and telegraph companies suffered in the same manner. The protection of these properties against a recurrence of such damage and destruction constitutes a direct benefit, but it does not follow that the amount of damage sustained during any past flood is a direct criterion as to the amount such property may be benefited.

The flood had a tendency to depreciate property values, but after the immediate effects of the disaster had been overcome and plans initiated to secure protection, values were maintained at more nearly what they would be with protection actually accomplished. It was therefore difficult to estimate present values. Those obtaining immediately before the flood could not be universally used as a basis for the appraisal of benefits because they had in some cases been wholly or partially destroyed. This confusion in values tended to complicate the appraisal problem.

The conservancy law of Ohio fully recognizes the difficulties inherent in establishing benefits, and gives the three appraisers wide discretionary powers, while fully protecting the property owners and communities by a number of appeal provisions.

Two Basic Requirements—Two conditions in the relation of benefits to cost were of critical importance. There were (1) the total of benefits must warrant the expenditure, and (2) equitable distribution must be accomplished.

Unless the flood-protection project should benefit the property owners within the district in real, demonstrable manner by an amount exceeding the cost of the project, it should not be carried out. The bonds would have an adequate margin of security and would find a ready market only in case the total benefit should exceed the cost of the proposed works by a very large margin (a ratio of 3 to 1 between benefit and cost is a satisfactory ratio). The Conservancy Court would no doubt have killed the project in case the cost of the proposed works had been nearly equal to the resulting benefits, or in case of obvious lack of equity in the distribution of appraisals as between different pieces of property in the flood territory, or in case the benefit appraisals could not stand the test of common sense.

Magnitude of Work—Viewed as a whole the appraisal work was an undertaking of very great magnitude. About 77,000 separate pieces of property had to be dealt with, distributed along 110 miles of river valley. In about one-fifth of the cases, damages were concerned; that is, the property would be taken in whole or in part for the construction of the flood-protection works. The other parcels were affected by benefits only. Whether damage or benefit, the definite amount had to be determined separately for each parcel. As a preliminary step complete engineering and property data had to be compiled.

Surveys and the determination of flood outlines indicated what properties would be affected. Engineers then prepared real estate maps of the entire territory, including the cities, and determined the depth of flooding by the flood of 1913 on each individual piece of property and the extent of the physical damages to property resulting from the proposed construction work.

Since many of the data required by the appraisers were of an engineering character, it became necessary for the engineering staff to assume a large part of the work of compiling and classifying data. Obviously, a close co-operation between appraisers and engineers was indispensable to the successful carrying out of the appraisal program.

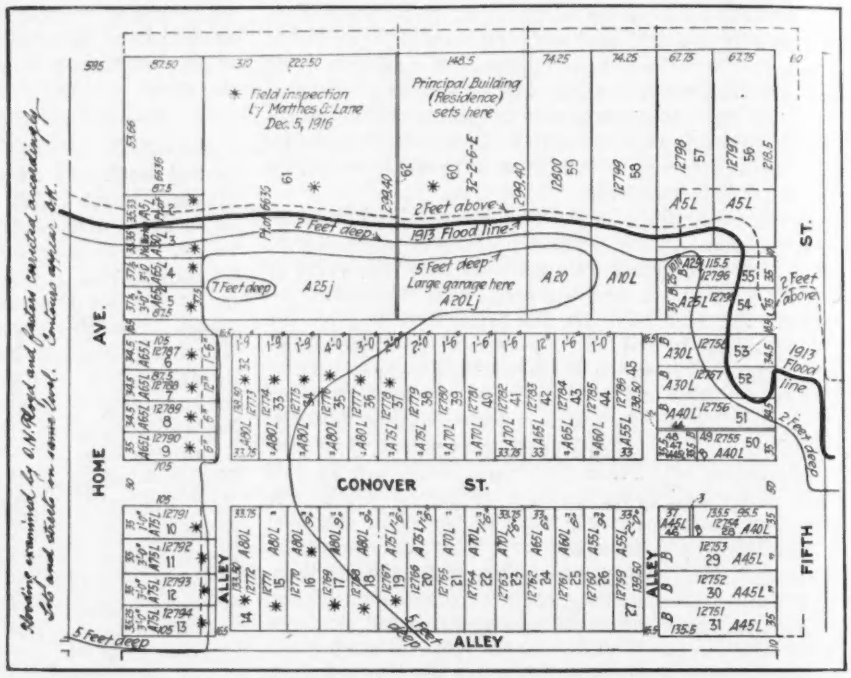
Benefit Equated to Depreciation—City property constituted by far the largest element of value in the district, and also that class of property on which the flood benefit was the most difficult to determine. It was not considered that the actual physical damage to any one piece of property in the 1913 flood had an identifiable relation to the benefit produced by flood protection. However, the depth of flooding during the 1913 flood was the basis of the curve of flooding factors, shown in Fig. 2.

"Flooding Factors"—The flooding factor was the device developed to insure a uniform determination of benefits on the town properties. Many considerations entered into the making of this curve. It is expressly emphasized by the engineers and appraisers that both the values and the variation represented in this curve are not generally applicable to other cases, or to property other than that considered in the Miami district, because of the large number of individual or locality influences concerned.

Generally speaking, the first-floor level of a house constituted the most important datum point with respect to flood height or submergence. When water

reaches the first floor the habitability of a house at once is directly affected. Again, in actual flood-time experience the condition of a house generally became critical and the last remaining vestige of habitability was destroyed when water reached the second-floor level. This consideration in fact was largely determinative in fixing 10-ft. submergence as corresponding to full depreciating effect of a flood.

However, it could not logically be concluded that the flooding factors would be in direct proportion to depth of submergence between zero and 10 ft. With shallow flooding the injurious effects are small except in interfering with entrance to buildings, use of streets, etc. At about 3 ft. depth or more, water ordinarily enters the first story, the streets are no longer fordable, and a considerable proportion of the entire injury in property depreciation has occurred. From 3 ft. to 5 ft. swift velocities develop, ingress and egress to and from buildings becomes practically impossible, damage is done to furniture and buildings, and danger to life develops. From 5 ft. submergence upward the conditions described become aggravated, but the increments of depreciation are small, until substantially full depreciation is reached at 10 ft. flooding depth. The lower portion of the curve purposely was left somewhat indefinite in order to allow latitude for judgment. This is because property bordering on the edge of the water or having portions inundated to inconsiderable depths required a range of factors, varying from zero to as high as 20 per cent, depending upon the circumstances of the case.



PARCEL PLAT USED IN FIELD CANVASS

Reproduction of a blueprint plat such as was used in determining flooding factors for city lots. It covers a section of Dayton. Contour lines indicate the water stage at the crest of the 1913 flood; in addition to the high-water line there are contours of the 2-ft., 5-ft., 7-ft. and 10-ft. depths, and a contour 2 ft. above water to indicate the rate of rise of the land not flooded. On each lot is written the flooding factor, preceded by a reference letter denoting the classification used and followed by the initial of the engineer who determined the factor. The asterisks indicate lots visited on field inspection. The numbers in feet and inches give depth of water on first floor of building at crest of 1913 flood. The serial numbers are those used in the tax duplicate.

These factors, described as applying to depreciation, apply conversely to the benefit resulting from protection.

Industrial Property—Related considerations governed the appraisals of industrial property. Special conditions, however, were always looked for and taken account of. For instance, if machinery was located in the basement it was exposed to injury the moment water entered the basement, and therefore the basement level was treated as first-floor level. Losses in machinery and similar shop equipment were in fact so prominent a feature of the flood damages observed in the past that a benefit appraisal fully equal in its percentages to that on residential or commercial property was considered appropriate, in spite of the fact that habitability and danger to life are not concerned, and that factory buildings are not often damaged or destroyed in floods.

Gain in Value by Flood-Protection—The next step was to determine that portion of the value of property due to complete elimination of the flood risk. It happens that there was a great decrease in values directly after the 1913 flood, due to the general realization of the flood risk; and this decrease was in effect the reverse of the increase of value which it was desired to estimate. Stated differently, the benefit to be determined was held to be that portion of the original market value that would be restored through flood protection.

Often this restoration was anticipated, and the restoration of values took place on the mere assurance that flood protection would be provided. In fact, to a very large extent values never dropped, for before the first shock was over plans for preventing flood injury were in progress and the people were assured that protection was feasible and would be secured. Prior to 1913, property values in such valley cities as Dayton and Hamilton were practically unaffected by fears of flood, and it could fairly be assumed that the values prevailing prior to 1913 represented the values with full flood protection; on the other hand, the values at which property was held during the five or six months following the 1913 flood did not represent fairly the depreciated values on account of the flood risk, because values were maintained in the hope that protection would be secured.

Six or seven of the largest property holders in downtown Dayton and a number of representative real estate experts were consulted as to the permanent depreciation in property value that would result in the city from a failure to secure flood protection. They discussed the matter and arrived at a figure of 40 per cent of the value with protection, as the difference in value with and without protection, for the most seriously affected properties, and hence the benefit which would result from flood protection. The most

seriously affected properties were the ones where the depth of flooding was 10 ft. or more, and where the flooding factor, discussed above, was 100 per cent. The same process was gone through in other cities with the help of corresponding groups of local men.

At a later stage of the work the figure of 40 per cent was reduced to 30 per cent as the basis of benefit, because calculations on this basis gave a sufficient total of benefits in the district for all purposes of financing, and there was no reason for encumbering the property beyond that point. However, the 40 per cent figure was then and still is considered a fair estimate of actual benefits.

In its simplest aspect the benefit appraisal consisted of first, appraising the market value of the property

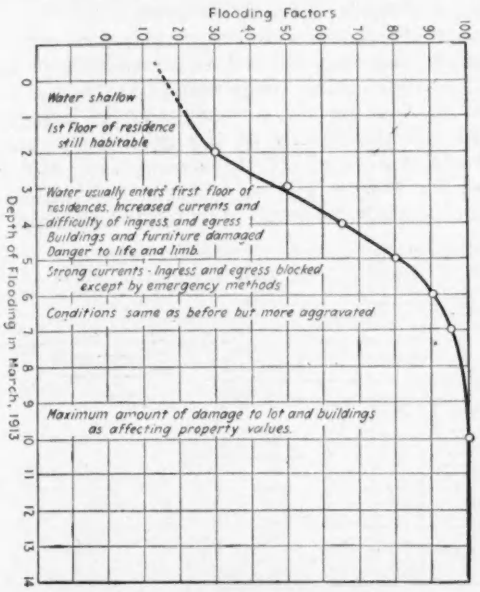


FIG. 2. CURVE OF FLOODING FACTORS
Notes under the curve indicate the conditions which commonly existed at the various depths of flooding.

benefited; second, determining, for each parcel, the physical facts relating to its flooding conditions, especially during the March, 1913, flood; third, determining the completeness of protection afforded; and fourth, applying the flooding factor to the 40 per cent (later 30 per cent) of the appraised market value. Since the proposed flood-control works provided complete protection for city property in most cases, the third factor was 100 per cent except as to a few situations.

Benefits to Communities—It was held that the elimination of the flood risk would benefit cities and other communities as municipal units, as well as the individual pieces of property. Consequently benefit appraisals were required on cities, counties, etc., as units.

Taking the case of a city: The flood-protection works give protection to all property owned by the municipality as such, and to all the property constituting the wealth and business strength of the community. When a flood paralyzes industry and all principal forms of community and business life, as it did in the Miami valley cities in 1913, it affects every human being living in the community and affects the value of every piece of property within its boundaries. Thus the flood-protection project would guard the assets of the city and assure the future existence, growth and prosperity of the community. That a destructive flood has far-spreading effects falling on the community as a whole may be seen from the fact, for example, that there existed for years afterwards numerous cases of pauperism, sickness, and insanity resulting from the 1913 flood; and such ill effects obviously fall as a burden on the community, and their elimination (for the future) constitutes a direct benefit to the community. Likewise the difficulty in a flood-menaced city of securing credit needed by business enterprises to properly carry on their business constitutes a definite deterrent to the normal growth and development of the city.

Upon considering the direct benefits to municipal property, and also the extensive but rather intangible effects of flood protection upon the city as a whole, it was concluded, after conferences with numerous officials, that the city as a unit would be benefited by an amount equal to the total benefits to its citizens individually. This conclusion applied to the larger valley cities except Piqua. For the latter a credit was allowed against the appraisal because of the fact that the city had already done certain work on its own account, and in consequence the city's net benefit was taken as half the sum of the individual benefits.

In determining the benefits to counties, the community benefit is not related in such clearly recognizable manner to the benefits accruing to individual property holders. Much county property was submerged and temporarily put out of use or damaged in the 1913 flood (and to lesser extent in the more frequent smaller floods). The values with and without protection of this property were estimated, and the difference taken as the measure of benefits. Loss of tax value resulting from the depreciation that took place after the 1913 flood was also carried into the benefit column, since similar loss of tax value would not occur under full protection. In all instances local business men were drawn upon for counsel as to the fairness of the values fixed on counties.

Property Outside of Cities—Benefit appraisals on individual parcels of country property were of necessity dealt with in a way quite different from that applied to city property. In the case of agricultural land, not used for residence, the injurious effects of flooding and consequently the benefit conferred by flood prevention probably would not be as great as on city property, and in some cases perhaps would be absent or negative. On the other hand, land which was ruined by either erosion or gravel deposition in the 1913 flood could not properly be considered to be benefited in high measure by future flood protection, as but little value remained to be protected. Creek bottom pasture land also had to be given a very low benefit estimate, as the actual gain here through elimination of future flood rises from the river would be almost negligible. Where buildings were involved, however, it was possible to base comparative benefit estimates on factors involving depth of submergence, somewhat as in the case of city property.

In the main the estimates for country property were in the largest measure based on conference of the appraisers with local experts such as retired farmers, after detailed personal inspection of the site and study of the flood conditions as revealed by the engineering plats. Agriculture benefits in the aggregate constituted less than 5 per cent of the whole.

Benefits to Utilities—Benefits to railroads were taken to involve the same quality and quantity factors as those

influencing the benefits to private property. Appraisals were based on physical value, being guided to some extent by valuation figures of the Interstate Commerce Commission, plus land value. The latter was appraised on an area basis at figures equal to that of the adjoining lands. This work throughout required the co-operation of both engineering and appraisal departments. Here also the amount of benefits appraised was as nearly as could be determined the difference in value with and without protection.

Street-railway benefits also were appraised on a basis of physical value including the land value; the latter, being only a right-of-way, was taken as 25 per cent of the ownership value of adjoining land (per square foot) and was estimated for a width equal to the track width plus 18 in. on each side. To the physical valuation thus determined, flooding factors were applied similar to those used for city property.

Power houses in the flood territory were treated like other buildings, using the same flooding factors and basing on 10 ft. depth as full submergence. Those located outside the flood territory, on the other hand, were appraised no direct benefits, though they contributed indirectly to the project the tax rate increase caused by the benefit assessments against the city and county as units.

In valuing wire-line property in the flooded area, values taken from the companies' inventories were generally used as bases. Full benefit, corresponding to the 40 per cent tentative depreciation effect of the 1913 flood on individual properties, was taken as 12½ per cent of the value.

This figure was later reduced 25 per cent to accord with the reduction from 40 per cent to 30 per cent previously mentioned, and the resulting figure was applied to the total value of the wire lines located in submerged territory. Similar methods were used in determining the benefits to other public utilities.

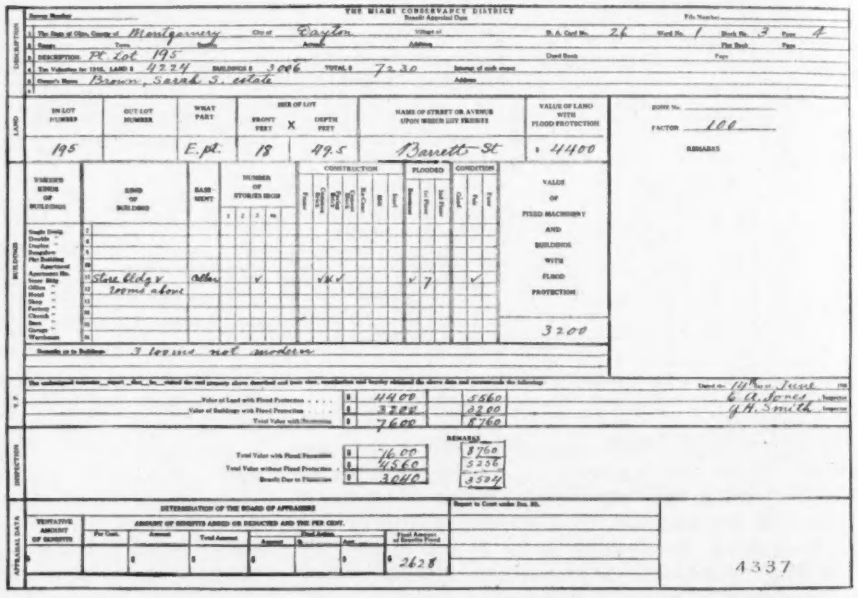

THE MIAMI CONSERVANCY DISTRICT

FIG. 3. BENEFIT-APPRAISAL RECORD CARD

It is important to note that throughout the benefit appraisal of both public service utilities and large manufacturing establishments, the appraisers and their agents consulted with the officials of the various companies, and obtained data from them which enabled benefit figures to be arrived at which at once were fair and satisfactory to the companies. By thus enlisting the co-operation of the companies much subsequent disagreement was avoided, as evidenced by the fact that practically no exceptions were filed by public service companies or manufacturers. With about 100 public service corporations affected by benefits or damages, amicable settlements were reached in all but three cases.

Large Benefit Total Found—When the benefits were compiled and totaled, it was found that the entire benefit in the district amounted to something over $100,000,000. Inasmuch as only about $25,000,000 to $30,000,000 was estimated to be spent on construction of the flood-protection works the ratio between appraised benefits and required assessments of benefits was considered to be unnecessarily large. Three times the amount of bonds to be sold for the construction of the works was believed to represent an ample benefit appraisal. Accordingly the initially determined benefit of 40 per cent for fully submerged property was reduced to 30 per cent, and all the appraisals correspondingly modified.

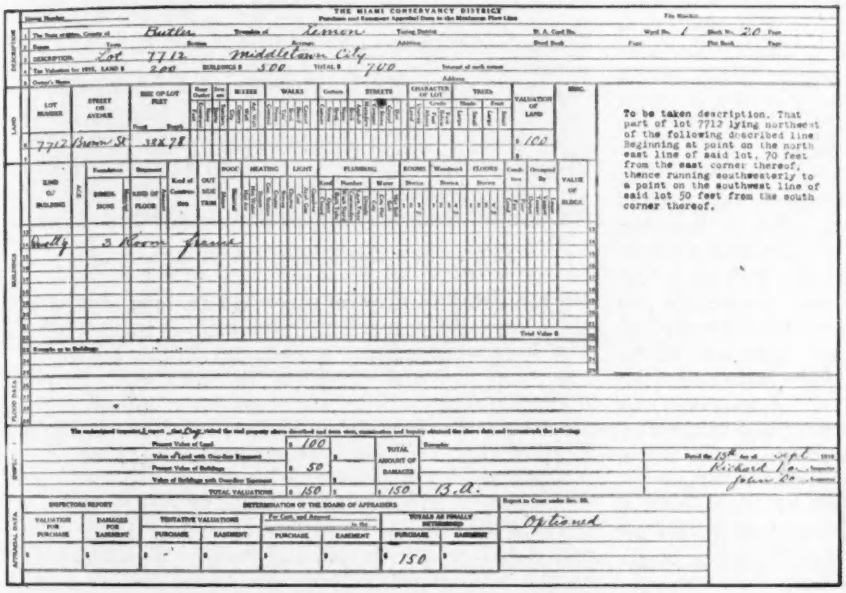
Of the nine counties included within the district, five (Miami, Montgomery, Warren, Butler and Hamilton) contained property that was benefited. The total benefits finally assessed in these five counties were: Individual benefits, $38,000,000; cities, $33,000,000; counties, $6,000,000; total, $77,000,000.

Damage Appraisals—The most extensive work in dealing with damages was that concerned with the lands in the retarding basins, which would be subject to overflow during flood periods, on account of the large areas involved and the novelty of the questions presented. Such lands as were actually to be occupied by the dams or used for borrow pits or otherwise necessary construction purposes naturally were bought outright and remain in the possession of the conservancy district. Outside of this range, however, the basin lands are not permanently withdrawn from the agricultural service of the community, since only those in the very bottom of the valley will be frequently flooded, and those near spillway level will be wetted only in the conjectural, improbable rainfall-and-flood contingencies on which the whole project is based as an ultimate possibility. The upper lands of the basins, therefore, might be considered as being not at all affected by the exposure. However, the farmers, knowing but little about the engineering details of the project, necessarily took a different view, and their estimates of the damage to which they would be subjected differed materially from that of the board of appraisers.

Much Basin Land Bought—When this situation was fully realized, the district decided to buy in fee simple

most of the basin lands. A smaller proportion of the total, chiefly the lands lying far up towards spillway level, was dealt with by purchasing an easement to put water on the land at irregular intervals, this easement including the right on the part of the district to require the removal of buildings from below a certain level, to prohibit all future building below a specified level, and in general to control the occupancy and use of the land so far as flood questions would bear on the matter.

The district determined a fair easement price on these lands after a field inspection, in which frequency and depth of flooding of the various tracts, the value and condition of the land, and other items were taken into consideration. This price, determined by the appraisers, was used as a guide in determining whether or not it would be necessary to buy the basin lands in fee simple.


THE MIAMI CONSERVANCY DISTRICT

Purchase and Easement Appraisal Data in the Miamiburg Flow Lines

Butler Lemon Middletown City

Lot 7712 Brown St 32X72

To be taken description. That part of lot 7712 lying northeast of the following described line: Beginning at point on the north east line of said lot, 70 feet from the east corner thereof, thence running southwesterly to a point on the southwest line of said lot 50 feet from the south corner thereof.

Shelly 3 Room Frame

Present Value of Land	$ 100
Value of Land with One-Size Basement	$
Present Value of Buildings	$ 50
Value of Buildings with One-Size Basement	$
TOTAL VALUATIONS	$ 150
TOTAL AMOUNT OF DAMAGES	$ 150

Dated the 13th day of Sept. 1916

Richard [illegible], Inspector

John [illegible], Assistant

INSPECTORS REPORT		DETERMINATION OF THE BOARD OF APPRAISERS					
VALUATION FOR PURCHASE	DAMAGES FOR EASEMENT	TENTATIVE VALUATIONS		Per Cent. and Amount to be Paid		TOTALS AS FINALLY DETERMINED	
		PURCHASE	EASEMENT	PURCHASE	EASEMENT	PURCHASE	EASEMENT
$	$	$	$	$	$	$ 150	$

Report to Court under Sec. 10. Optioned

FIG. 4. PURCHASE AND EASEMENT APPRAISAL DATA

Special procedure was adopted in a few individual instances, namely, an agreement was made with the owners of the land to pay damages due to flooding caused by the works of the district when damage occurs.

Land Resold—The lands in the basins purchased by the district have recently been put on sale, full information being supplied to intending purchasers as to the susceptibility to flooding and the probable effects of flood ponding upon the agricultural value of the lands. The net result to date is that an average sale price of about 85 per cent of the price at which the land was purchased has been realized, and in individual instances land has even been sold at higher figures than those paid by the district. Thus, it may be stated that the practical outcome of the methods used is to make the cost of the flood easement in the lower part of the basins about 15 per cent of the full value of the land. These figures are derived from sales representing about 20 per cent of the total area which the district expects to dispose of. As the sales continue these figures may have to be modified.

In proceedings under the conservancy law no separate condemnation of different parcels is required. Accordingly, all the damage and benefit appraisals were submitted to the court in itemized form in a single appraisal roll, objections by property owners were heard by the court, and a decision was reached both as to the entire roll and as to individual parcels. The final court order contained both an easement price and a purchase price for each particular piece of damaged land, and the directors of the district were free to take over the easement or take over the property, at the figures entered in the order.

Results of the Appraisal—About 1,900 exceptions were taken by property owners to the appraisals of benefits and damages made by the district on about 77,000 parcels. Of the cases in which exception was taken to the district appraisals, not more than 500 were appealed to the Conservancy Court.

Expressing this in percentage figures it might be said that the district appraisal, carried out by the methods outlined in the preceding, proved something over 99 per cent efficient when measured by the attitude taken by the property owners affected, and substantially 100 per cent efficient when measured by the action of the court. In only a dozen or two cases were the exceptions and appeals made by the property owners effective in leading the court to modify the figures of the district.

Large Force Engaged in Work—As the whole appraisal undertaking dealt with some 77,000 parcels of land, a large organization had to be built up to deal with it. In control of the entire work there was a board of three appraisers appointed by the Conservancy Court, and consisting of J. Edward Sauer, Charles W. Kiser, and Samuel M. Goodman, three business men who were thoroughly acquainted with real estate values in the Miami valley. Great credit is due these men for the faithful and absolutely impartial manner in which they carried out the gigantic task assigned them. It required their close personal attention for a period of over a year, during which they had to sacrifice many of their private and other interests.

They were assisted by a large engineering and clerical force supplied by the district, a force of about 100 field inspectors alone being required. In the cities these inspectors were equipped with copies of the county auditor's plats, and in the country districts with plat maps supplied by the engineering department, upon which the flood outlines had been traced. The appraisers' inspectors were concerned primarily with determining actual values, which they entered on inspection sheets (see Figs. 3 and 4 for specimens), to be reviewed later by the board of appraisers themselves.

The appraisal board in person viewed every site and every parcel of property concerned, verifying and correcting the appraisals of the various field inspectors.

Dismantling 150-Ton Shear Legs in Havana Harbor

Landmark Removed to Make Way for New Port Works—Tubular Legs Weighing 18 and 25 Tons Swung by Aid of 90-ft. Tower

By F. J. Litter
Chief Engineer, Frederick Snare Corporation, New York

In order to provide space for additional port facilities in the harbor of Havana, Cuba, the Port of Havana Docks Co. has recently found it necessary to remove one of the few remaining landmarks of the old Spanish régime. Visitors to Havana have noticed a large tripod shear-legs, one of the first objects to meet the eye in the harbor, and known as "La Machina."

It was purchased by the Spanish government from an English concern in Southhampton, and erected about 1880. The shear-legs was intended for the handling of ordnance, munitions, and other heavy weights. It is said that it has been used but three times; once prior to the Spanish-American War, and twice since, once to set ashore a gun turret and guns from the U. S. S. Maine to form part of a monument to be erected to the men who lost their lives in that explosion.

"La Machina" was of 150 tons rated capacity. The legs were tubular, built up of ½-in. plate with riveted joints. The two front legs were each 136 ft. long and of tapering diameter, with a maximum near the center of 44 in. The weight of each was about 18 tons. At the lower end they were pin connected to concrete and cast-iron pedestals which rested on the bulkhead, and at the upper end they were similarly connected to the back leg. The pin at the upper end carried also the upper block of the hoisting falls. The back leg was 170 ft. long, of tapering diameter with a maximum of 48 in., and weighed approximately 25 tons. The whole rig when in a vertical position stood 142 ft. above the bulkhead level, including the height of the pedestals. Hoisting falls were of 1¼-in. diameter chain with nine parts running over blocks of 4 and 5 sheaves of 30-in. diameter. Movement backward and forward was controlled through the back leg which at its lower end was pin connected to a worm screw, 40 ft. long, driven by an independent connection to the main hoisting engine.

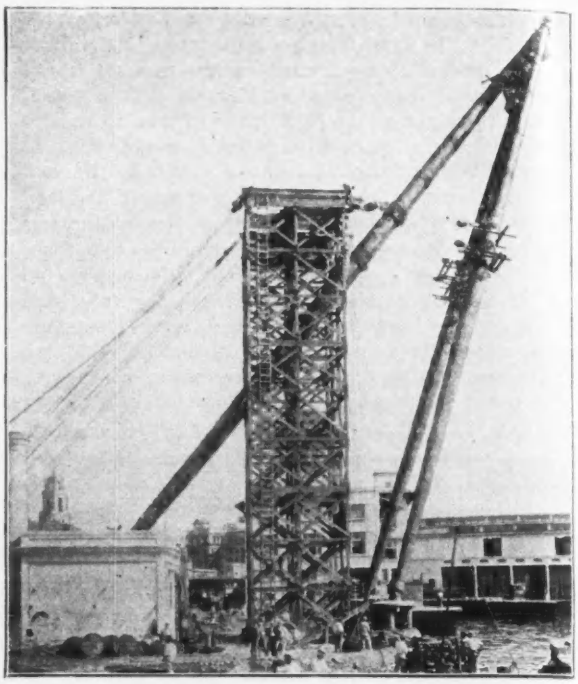


FIG. 1—LOWERING EQUIPMENT IN PLACE

A 90-ft. wooden tower was erected directly behind the two front legs and straddling the back leg. To this tower lowering tackles and guys were passed. The shear-legs was then pushed forward by its own power to its point of farthest reach when all lowering tackles were hauled tight. The connection between the back leg and the two front ones was then broken by cutting through the back leg near the top with an acetylene torch. This was then moved backward and lowered simultaneously until it was entirely separated from the two front legs and the position of minimum strain on the tower was reached. The two front legs were then lowered as one until they were rested on cribbing placed on a deck scow. In order to relieve the buckling strain in these legs during the last 30 ft. of lowering, a 40-ton capacity derrick scow was hooked on to the outer end and lowered simultaneously with the main lowering engine on shore. The lowering of the back legs was then completed, all pins were taken out, and the three legs loaded separately on scows to be taken to the site designated by the government.

The work was done by the Frederick Snare Corporation of New York and Havana, subcontracted from the Parklap Construction Co., and under inspection of the Obras Publicas.

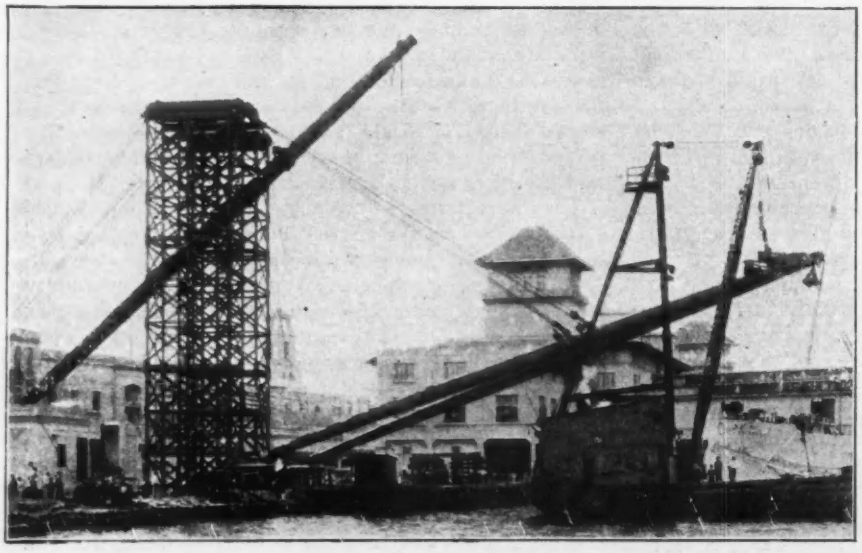


FIG. 2—FRONT LEGS BEING LOWERED TO SCOW
The floating derrick has taken hold of upper end of legs, to reduce bending stresses.

Studies of Discharge of Sanitary Sewers at Phoenix

Total Discharge Curves Compared With Other Cities Velocity Tests, *n* Value, Per Capita Flow Relation to Water Consumption

By S. M. Cotten
Assistant City Engineer, Phœnix, Ariz.

In connection with the extension of the sanitary sewer system of Phoenix, Ariz., a study was made of the conditions obtaining in the then existing system. This study developed some facts which are believed to be of general interest, and which are here given.

Phoenix is a residential city with a population of 29,053 in 1920. The sanitary sewer system is composed of three mains and their laterals. The mains are known as the Original, the North, and the South. The Original serves the retail business and office district, and empties into the South Main. The North Main serves the greater part of the area of the city, but a purely residential territory. The South Main serves a very mixed residential, warehouse, and shop district. The North and South Mains combine to form the Outfall, through which the flow is carried to septic tanks and discharged into the Salt River. Flow readings were taken at various points on these several lines.

In taking readings for depth of flow, the distance from invert of pipe to a fixed point on the manhole ring was read and recorded. Thereafter, readings were taken from this point to the water surface, the difference being the depth of flow. Measurements were made with an ordinary Philadelphia level rod, and the instant that the bottom of the rod came into contact with the water surface was clearly shown by the formation of ripples. The method gave quite accurate and satisfactory results. The size and grade of the pipe were known, and the discharge was computed on the basis of Kutter's formula, with *n* equal to 0.013, unless otherwise noted, and by a proportional discharge chart, shown by Fig. 1.

Discharge Curves—In order to arrive at some conclusions as to the applicability of generally available data to Phoenix conditions, the total Phoenix discharge curve was plotted against the combined discharge curve for seven cities, as shown on p. 191, Vol. 1 of Metcalf & Eddy's "Sewerage." The result is shown by Fig. 2. Considering the great dissimilarity of the communities represented, the practical identity of these curves, except for the time element, is remarkable. This difference in time is readily explained by the character of the cities represented.

For various reasons, it was necessary in some cases to take depth readings at manholes where there was a material change of grade in the sewer, and a corresponding change in the hydraulic properties of the line on either side of this point. In order to compute the discharge, it was necessary to determine whether the depth as read applied to the reach above or below the manhole. No statement covering this case could be found in the textbooks available. Theoretical speculation led to the belief that the depth would apply always to the reach below, and tests were made which verified this conclusion. For this purpose, simultaneous readings were taken at three consecutive manholes on the same main line, connected by quite different grades. The discharge of these lines, running full, beginning at the lowest reach, is 15.66, 12.76, and 23.75 sec.-ft. respectively. The depth readings applied to the reaches below the point of reading gave discharges of 3.06 and 3.13 sec.-ft.; applied to the reaches above, they gave discharges of 2.83 and 5.70 sec.-ft., showing quite conclusively that the correct application was to the reach below. This conclusion was further verified by velocity measurements of actual discharge over the same reaches, the method for which will be described later.

Readings were taken on the North and South Mains at points close to their junction, and on the Outfall at a point close below this. The main series of these readings covered a period of forty-eight hours, taken at half-hour intervals, and as nearly simultaneously as possible. The discharge curves for this period are shown in Fig. 3, on a basis of *n* equals 0.013.

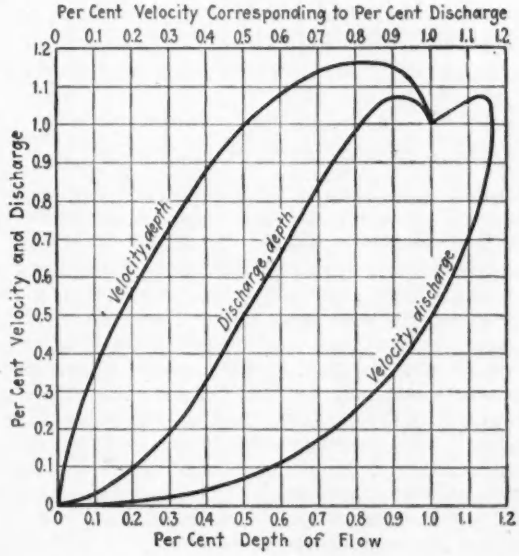

Per Cent Velocity Corresponding to Per Cent Discharge
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2
Per Cent Velocity and Discharge
1.2 1.1 1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0
Velocity, depth
Discharge, depth
Velocity, discharge
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2
Per Cent Depth of Flow

FIG. 1. COMPARISON OF HYDRAULIC FUNCTIONS OF CIRCULAR SEWERS RUNNING PART FULL AND FULL
All percentages refer to like functions for a pipe running full.

Making allowance for the time interval involved, it is apparent that the sum of the computed discharges from the North and South Mains should equal the Outfall discharge. But, on the basis of the depths as actually read, and a value of *n* equal 0.013, the former was very considerably in excess of the latter. The character of the several lines and of the flow in them indicated that the depths of flow for the North Main were in error. To determine this, simultaneous readings were taken at the point on this line where these readings had been taken, and at points adjacent above and below. These readings and the corresponding computations indicated that the original readings were in error by an amount of depth equivalent to 0.50 sq.ft. of flow area. This error would be a constant, irrespective of the depth of flow, and was apparently occasioned by a small dam or other obstruction in the pipe a short distance below the point of measurement. The necessary computations were made and the depths as read changed accordingly. Combining the corresponding discharges with those of the South Main, it was then found that their sum was somewhat less than that of the computed Outfall discharge, as shown on Fig. 4.

Velocity Tests—In an effort to clear up this discrepancy, a series of velocity tests were made on all of these lines, designed to give the actual discharge within

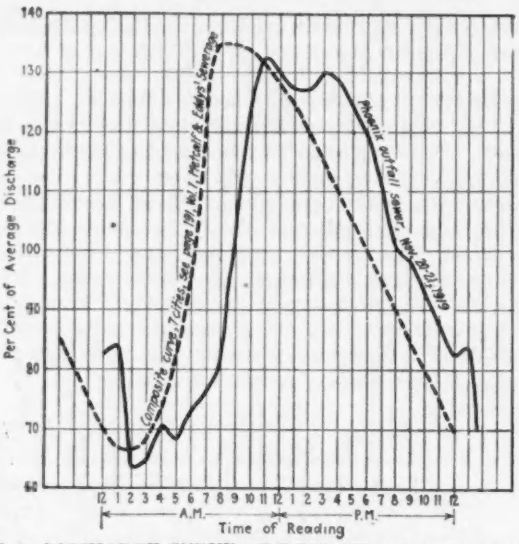

Per Cent of Average Discharge
Time of Reading
A.M.
P.M.
Phoenix outfall sewer, Nov. 20-21, 1919
Composite curve, 7 cities, See page 191, Vol. 1, Metcalf & Eddy's Sewerage

FIG. 2. DISCHARGE CURVE OF PHOENIX OUTFALL SEWER AND COMPOSITE CURVE FOR SEVEN CITIES

reasonably accurate limits. The tests were made at the time of maximum flow, when there was a good depth in the pipes, and this depth was essentially constant during the period of the tests. Four floats were put through the selected reaches, and accurately timed. The first three floats were small circular discs, designed to give the maximum surface velocity, and to serve as a check on the fourth. This last was a specially constructed apparatus, consisting of two circular segments of heavy red pressboard fastened together at right angles and securely braced with string. They were cut to a diameter 3 in. smaller than that of the pipe for which they were intended, and had wooden strips fastened to their tops so as to float them with their bottoms about 1½ in. from the invert. It was expected that these floats would give the average velocity of flow very closely, and the evidence indicates that they did.

For the North Main the average velocity of the three disc floats was 2.65 ft. per second, and for the special float the velocity was 2.39 ft., being 90.4 per cent of the surface velocity. With this velocity and the measured area of flow, the discharge was 2.43 sec.-ft. and the corresponding value of n is 0.01173.

For the South Main the discs gave a surface velocity of 2.92 ft. per second, and the special float an average velocity of 2.74 ft., being 93.9 per cent of the former. The corresponding actual flow was 3.81 sec.-ft., and the corresponding value of n is 0.01111.

For the Outfall, the discs gave a surface velocity of 2.27 ft. per second, and the special float an average velocity of 2.06 ft., being 90.8 per cent of the former. The corresponding actual flow was 6.35 sec.-ft., and the corresponding value of n is 0.0125.

Combining the North and South Main discharges, we have a sum of 6.24 sec.-ft., as against the 6.35 sec.-ft. computed Outfall discharge, which for such work is a very close check and much better than was anticipated. In connection with the velocity test on the North Main, depth readings were taken at points and computations made which gave a very close check on the conclusions heretofore noted concerning the reach to which readings are applicable, and as to the existence and effect of the obstruction in the line.

Actual Discharges and Water Consumption—The actual values of n for the three lines having been determined as above, the corresponding actual discharges were computed for the 48-hour readings, and the two main-line flows combined. This was plotted against the Outfall discharge, as shown on Fig. 5, and, in general, gave a reasonably close agreement. At least, it is much closer than in the case where a value of n equals 0.013 was used throughout, as in Fig. 4.

During the period of the 48-hour readings, observations were made also of the water pumped at the city water-works. These readings were averaged over a period of an hour and a half and their curve plotted on Fig. 5, the time being 1¾ hours later than the average reading time, to allow for the water reaching the Outfall. It will be observed that this curve is essentially parallel with the curve of Outfall discharge, and that the difference in quantity represented is not greater than would naturally be expected. The relation here indicated between water pumped and sewage discharge will hold good only during the winter months, when practically no water is being used for lawn sprinkling; there would be little similarity between these curves during the summer months.

For the purpose of the following discussion, the relative sewer discharge is equally as usable as the actual,

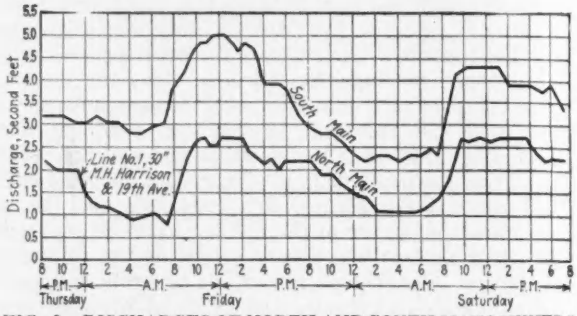


FIG. 3. DISCHARGES OF NORTH AND SOUTH MAIN SEWERS Based on n = 0.013. Measurements Jan. 20-22, 1921.

so a value of n equals 0.013 will be adopted and conclusions reached on this basis.

Readings were taken daily at the same points on the main lines for a period of one week. They were begun well before and ended well after the peak flow had passed. Contrary to all expectations, the maximum flow in the North Main was found to occur on a Sunday, about noon, at which time it was 17 per cent greater than the maximum for any other day of the week. This line, it will be remembered, serves a purely residential district. The maximum Sunday flow of the South Main was somewhat less than its greatest daily maximum, which occurs on a Monday.

The readings above referred to were taken in January. At this time of the year the daily per capita water consumption is about 145 gal. During July this rate rises to about 220 gal. It might be anticipated that there would be a somewhat proportional increase in the summer maximum rate of sewage discharge over that for the winter. Such is not the case, as readings taken the previous July show essentially the same maximum rate as those for January. It appears that the daily peak flow during the summer covers a considerably longer time than it does in the winter, and that there is a consequently greater volume of sewage, but not a greater rate of discharge.

The maximum rate of discharge of the North Main was 3.20 sec.-ft., of which 0.47 sec.-ft. was contributed by a district entirely outside of the city. The remain-

ing 2.73 sec.-ft. was contributed by 3,566 actual house connections, making the maximum rate per connection equal to 0.00076556 sec.-ft., or 494.76 gal. per day. This rate checked surprisingly well with readings taken at various points along the North Main, the number of contributing connections above such points being known.

Per Capita Discharges—The total number of residential sewer connections in the city is roughly 5,000, and the population is 30,000. It is conservative to say that at least 25,000 of the people live in residences connected to the sewers, giving an average of five persons per connection. Considering only the North Main, the per capita sewage discharge then is 98.95 gal. per day. At the same time the maximum rate of water pumped was 10 sec.-ft., or 215.5 gal. per capita per day. It might appear, then, that of this water, only 46 per cent finds its way into the sewers, but such a conclusion would be entirely erroneous, as a study of the distribution of the total sewage flow will show.

During the 48-hour readings, the maximum actual discharge from the South Main was 5.86 sec.-ft., and of the North Main, 3 sec.-ft., giving a sum of 8.86 sec.-ft. This as against a computed actual discharge of 8.66 sec.-ft. in the Outfall, and a water pumpage rate of about 9.5 sec.-ft., showing that the water pumped is approximately accounted for by the total sewage discharge. The 5.86 sec.-ft. discharge of the South Main was contributed by 2,350 connections. Of these, 1,360 were contributary to the Original Main, which developed a maximum discharge of 2.46 sec.-ft. The balance, or 3.40 sec.-ft., was developed by only 990 connections, whereas on the North Main it required 3,566 connections to develop 3 sec.-ft. This is accounted for by the fact that the North Main serves a purely residential territory, whereas the South Main serves a mixed residential, warehouse, and shop district, and it is evident that the rate of water consumption in these districts was proportional to their rates of sewage discharge. It appears further that the per capita rate of water consumption as above established is really of no significance; that the residential districts do not consume any such amount of water; and that most of what they do use finds its way into the sewers.

Because of the different character of the properties

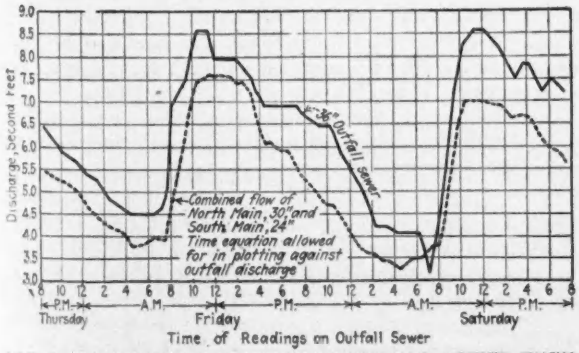


FIG. 4. COMPARISON OF FLOW IN OUTFALL SEWER WITH OBSERVED FLOW IN NORTH AND SOUTH MAIN TRIBUTARIES ADDED TOGETHER

Based on $n = 0.013$. The combined discharges should equal the discharge through the outfall. Observations made Jan. 20-22, 1921.

served in the retail business and office district, it is evident that a rate per connection would have no significance. It was thought, however, that a per capita rate for this district would have some value for the purposes of this study and for predictions as to ultimate developments. Consequently, a census was taken of the people engaged or living in this district during business hours, including hotel and rooming-house guests. It was found that there were 9,300 such. Dividing the maximum sewage discharge of 2.46 sec.-ft. by this number gives a rate of 0.0002642 sec.-ft., or 171 gal. per capita per day. It will be observed that this rate is 73 per cent greater than the residential per capita rate as previously established.

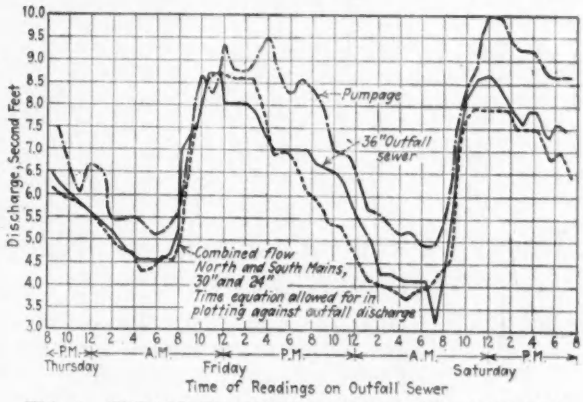


FIG. 5. SEWAGE DISCHARGE AND WATER PUMPAGE

Sewage discharges based on velocity tests. Water pumpage based on half-hour readings averaged over 1½ hr.; curve plotted 1 hr. 45 min. later than average reading time. Observations on Jan. 20-22, 1921.

Conclusions—The principal conclusions of this study may be summarized as follows: (1) The size, grade, and depth of flow of an ordinarily well constructed vitrified clay sewer being known, the corresponding discharge will be given approximately by Kutter's formula, using a value of n equal to 0.013. The actual discharge may be determined very closely by the use of a special float, such as described, giving the average velocity of the flow. The values so derived indicate that the actual value of n is somewhat less than 0.013, and the discharge correspondingly larger.

(2) In taking readings of depth of flow, a point on the line should be selected where the flow is in a state of passive equilibrium; that is, where, for considerable distances on either side, there is no change of grade, size, or alignment of pipe. If it is necessary to take readings at a point where grade or size changes, it is indicated that the depth as found will always apply approximately to the reach below, or downstream.

(3) It is possible that there may be a dam or obstruction of some character in the pipe, a short distance below the point of reading, resulting in increasing the depth over what it should be. To guard against this, a point selected for readings should be investigated and checked by taking simultaneous readings at this point and at another one immediately above or below. If these readings give approximately identical discharges, a free flow through the pipe is indicated, and the selected point is acceptable.

(4) It is indicated that the characteristics of the total sewage discharge curve for a small residential city are practically identical with the curves as heretofore established for large commercial cities, except for a probable difference in time. The maximum flow will be about 135 per cent of the average.

(5) A per capita rate of water consumption or of sewage discharge, based upon these total quantities and the total population, is meaningless and misleading.

A per capita or a connection rate is of significance only when determined for or applied to, districts of uniform character. The residential rate will be very much smaller than that of a mixed commercial and residential district; the former may be only one-half to one-fourth of the latter, and in the design of a sewer system this fact should be given due study and consideration.

(6) The maximum rate of sewage discharge is practically constant throughout the year, though the total discharge varies, increasing in the summer. The maximum residential rate of discharge occurs on a Sunday, about noon, and is 17 per cent greater than the maximum for any other day of the week.

Heavy Concrete Pavement on Wide Chicago Boulevard

Mat Reinforcement of ½- and ⅜-In. Bars—Slab Built Half at a Time — Transverse Joint Every 25 Ft.—Large Arc Curb Corners

A SECTION of concrete pavement 55 ft. wide and 12 in. thick, heavily reinforced with steel bars, has been constructed as part of the future development planned for Sheridan Road in Chicago. The location of the new pavement was open Lake front only a year ago. During the winter of 1921-22, the area was filled in with cinders and earth to a depth of 8 to 16 ft. As settlement of this "made ground" was to be expected, a heavy concrete pavement, strongly reinforced, was decided on and a particularly well-drained subgrade planned.

A plan of the new pavement showing the joint arrangement, the drainage system and the wide curves of the curb corners at intersections is shown by Fig. 1. The slab is uniformly 12 in. thick and is 55 ft. wide between curbs. There is a continuous longitudinal joint at the center and transverse joints about every 25 ft. except at intersections where the spacing is irregular. The longitudinal joint is merely a construction joint except that the edge of the slab first laid is painted with hot asphalt before placing the abutting concrete. Along the curbs, which were built separate from and after the pavement slab, there are similar paint joints. The transverse joints are ⅜-in. fiber matrix joints. Across both transverse joints and the center longitudinal joint, ¾-in., 5-ft. dowels are spaced 5 ft. apart.

The slab reinforcement consists of ½- and ⅜-in. bars fabricated into rigid mats. Except for the weight of the reinforcement, about 125 lb. per square, the mat construction is that commonly employed. Each slab between

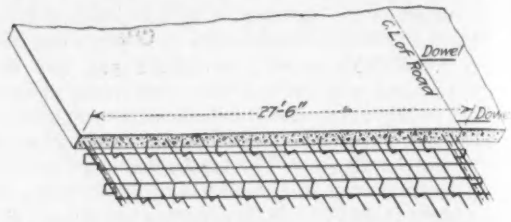


FIG. 2—ARRANGEMENT OF REINFORCEMENT

joints is separately reinforced, the dowels being the only steel that crosses the joints.

As indicated by Fig. 1, subgrade drainage was given especial attention. The general grade line was flat, so it was necessary to provide for surface drainage by alternate high and low spots in the gutter flow line. Catch basins were built 150 ft. apart in each gutter and connected by 6-in. tile pipe with a storm-water sewer paralleling the pavement on the Lake-shore side.

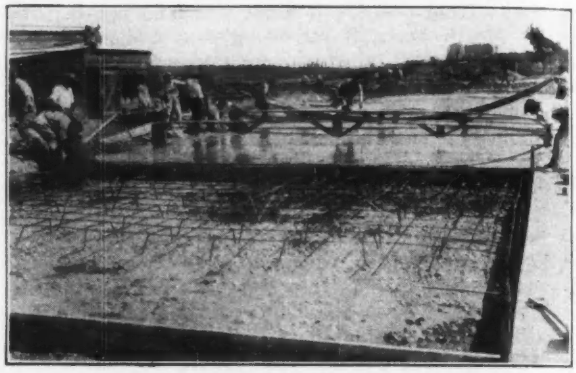


FIG. 3—BELT FINISHING HALF-SLAB UNDER CONSTRUCTION

No unusual equipment or methods were employed in constructing the pavement. It was force-account work with the regular road-building equipment of the Lincoln Park Board. A 1:2:3 concrete of washed and screened sand and pebbles was employed. The slab was constructed a half at a time and Fig. 3 shows the finishing operations on a half slab. By building the slab half at a time, belting was possible with no more than the usual labor. A paving mixer with boom and bucket distribution placed the concrete and was charged from stockpiles on the grade. The slab was cured by ponding.

Construction of this extension was under the direction of H. A. Marbach, chief engineer of Lincoln Park Board.

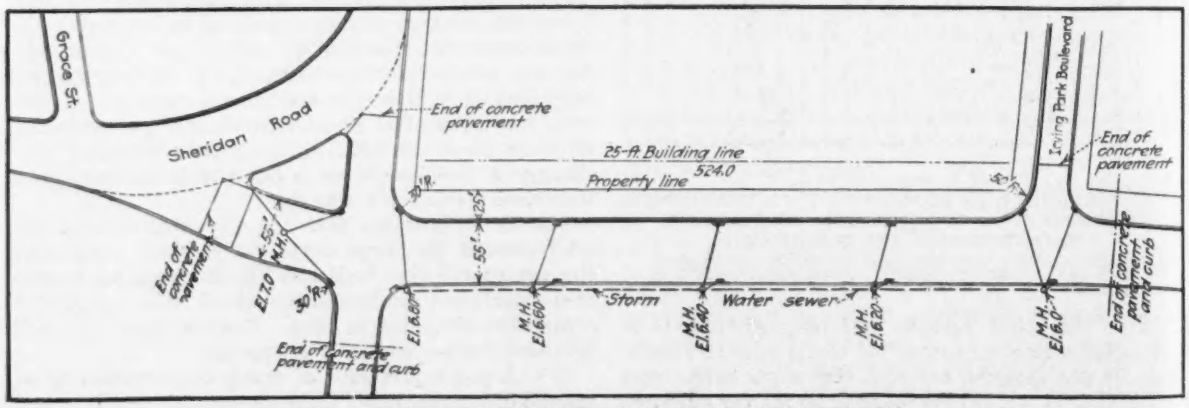


FIG. 1—PLAN OF JOINT LOCATION AND DRAINAGE SYSTEM

Illinois Central Announces Plans for Chicago Terminals

Begins 18-Year Program of Improvement on Suburban and Terminal Electrification and Lake-Front Park Extension

IN ADOPTING the 1,500-volt direct-current system with overhead wires for the electrification of its Chicago terminal lines the Illinois Central R.R. has taken an important step in its extensive program of improvements for these lines, which program covers a construction period of approximately eighteen years. Besides the electrification the program includes a large passenger terminal station with tracks on three levels, a separate suburban terminal, track depression with concrete retaining walls, track elevation, revision of trackage and provision of additional tracks on about 38 miles of line, sewer alterations necessitated by the track depression, and extensive filling for land reclamation along the lake shore. Parts of these works are now under construction. A stock issue of $50,000,000 for this and other work has been authorized by the railway company and the first $10,000,000 issue has been approved by the Interstate Commerce Commission. The extent of the electrification is shown in Fig. 1.

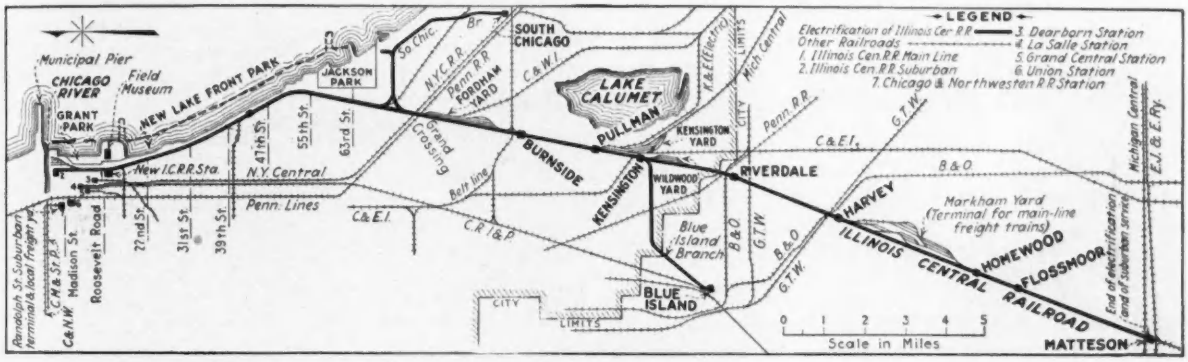


FIG. 1—ELECTRIFICATION AND LAKE-FRONT IMPROVEMENT ON THE CHICAGO TERMINAL LINES OF THE ILLINOIS CENTRAL R.R.

North of 51st St. the improvements along the shore have been planned in co-operation with the South Park Commission for the new lake-front park which will give the city a continuous park along the shore outside of the railway tracks where now there is deep water. This great public improvement was described in *Engineering News-Record*, Aug. 21, 1919, p. 360, and is indicated also in Fig. 1.

Report on Electric Traction Systems—Abandonment of the use of steam locomotives on the Illinois Central R.R. lines within the city limits except for interchange with other railroads and for trains of perishable freight, is provided for in an ordinance passed by the city and accepted by the company in 1919 (see *Engineering News-Record*, Aug. 21, 1919, p. 360). Late in 1920 a commission to consider the electrical systems best adapted to the conditions of the terminal service of this road was appointed by C. H. Markham, president of the company, with the late A. S. Baldwin, vice-president, as chairman. The other members were D. J. Brumley, chief engineer of terminal improvements, I.C.R.R., and three consulting engineers, George Gibbs, Bion J. Arnold and Dr. Cary T. Hutchinson. The secretary was W. M. Vandersluis, formerly signal engineer of the railway. Much investigation work was done by Hugh Pattison, electrical engineer for the commission.

A special and unusual feature of this problem is that the lines to be electrified include not only heavy suburban and main-line passenger service but also extensive freight switching in yards and freight transfer between yards of numerous railways. Four principal electrical systems were considered: (1) 750-volt direct-current with third-rail conductor; (2) 1,500-volt direct current; (3) 3,000-volt direct-current, and (4) 11,000-volt alternating current, these last three using overhead wires. The third-rail system was rejected as unsuitable for an installation including extensive freight yard trackage and switching.

With low voltage, the cost of line equipment is relatively high and that of electric train equipment relatively low. Therefore the 1,500-volt system was found economical in this case, since the installation is short but involves a large number of motor equipments for heavy traffic. Furthermore, it is purely a terminal installation and does not include any main-line division. Nor is there any intent or prospect of extending electrification for adjacent main-line service, since electric traction is not considered as offering any advantages under the operating conditions of the Illinois Central R.R. and was adopted only because of the city's demand for the elimination of steam locomotives within the city in the interest of smoke abatement.

Taking these several conditions into consideration the 1,500-volt system was recommended by the commission and has been adopted. Details of the system will now be worked out, including a main power house and several substations. Electric locomotives will handle the main line trains, transfer service and yard switching, but motor cars operating on the multiple-unit system will be used for the suburban trains. Electric train equipment will be designed for a speed of 50 m.p.h., with an acceleration rate of 1.5 m.p.h. per second and a deceleration or braking rate of 1.7 m.p.h. per second.

Electrification Program—Although the ordinance covers only tracks within the city the electrification will have to be carried 11.6 miles south of the city limits to Matteson, as this is the terminal of the suburban service. The electrified lines are shown by the map. The company's line running west at 16th St. is not included in the ordinance. Four stages of the work are prescribed, as follows:

1. By 1927, the entire suburban passenger service

is to be equipped, including the main line to Matteson, 28 miles, with the 4.5-mile South Chicago branch and the 4.4-mile Blue Island branch. This will include about 125 miles of track. The great passenger terminal at Roosevelt Road and the city suburban terminal at Randolph St. are also to be completed by 1927. About 240 motor cars for multiple-unit trains will be required, operating a daily service of 350 trains making about 5,000 miles. This suburban traffic during 1921 amounted to nearly 20,000,000 passengers, or about 30 per cent of the total Chicago suburban traffic handled by steam railways.

2. By 1930, all freight service north of Roosevelt Road is to be operated electrically. This involves more than 40 miles of track which is mainly yard trackage, so that special problems are involved.

3. By 1935, all freight service within the city limits is to be electrified. To provide for the large amount of interchange with other roads, however, steam locomotives will be permitted to operate over the electric lines for transfer service. Thus a train of cars for delivery to some other road may be operated by steam from the Markham freight yard northward to destination, and the engine may return with a similar train, but no switching movements within the electrified zone may be made during the trip. The Markham yard, which is not yet finished, will be the terminal for main-line freight trains, as described in *Engineering News-Record* of Aug. 5, 1918, p. 313.

4. By 1940, the through passenger service is to be electrified within the city limits. The ordinance provides, however, that this work may be deferred if at that time the steam trains of tenant roads using the new terminal station constitute more than 20 per cent of all the trains using that station. What these tenant roads will be is not now known. At the present time the Illinois Central R.R. terminal facilities are used by the Michigan Central R.R., the Chicago, Lake Shore & South Bend Electric Ry. and the Cleveland, Cincinnati, Chicago & St. Louis Ry. The first two lines diverge at Kensington, the electric trains being handled by steam locomotives on the Illinois Central tracks. The third railway continues south over the main line as far as Kankakee.

Work Now in Progress—A great amount and variety of work is required preparatory for the electrification, and the following is a summary of work now under construction and to be carried out during the next five years. Contracts amounting to over $1,000,000 have already been let for parts of this work.

1. A dam or bulkhead is being built to enclose an area of the lake between 16th and 23rd Sts. and thus provide about 47 acres for deposit of excavated material from grade revision and other works. This dam, requiring about 110,000 cu.yd., is a fill formed by suction dredges and having slopes of about 1 on 20, as shown in Fig. 2. It is being built by the Great Lakes Dredge & Dock Co. in connection with similar work for the South Park Commission. Another dumping area of about twenty acres is being formed by 1,100 ft. of pile and rock breakwater off the shore at 29th St. to 31st St. This breakwater is being built by the same contractor.

2. Grade revision is being carried out to lower the tracks between 25th and 41st Sts. in order to give the required headroom for overhead viaducts to be built by the South Park Commission to provide communication with the park extension along the east side of the railway. The grade will be lowered about 10 ft., or to an elevation 4 ft. above the lake level. This work will be completed in 1923 and a contract for the first 700,000 cu.yd. of excavation was let in August, 1922, to the States Contracting Co. Concrete retaining walls on the west side of the depressed tracks will be built from 30th to 41st Sts. and will be largely of the L or counterfort type as they must be kept within the right-of-way line. These walls will contain ducts for electric wires and will carry supports for the overhead wire system. From 44th to 51st Sts., the present tracks will be elevated.

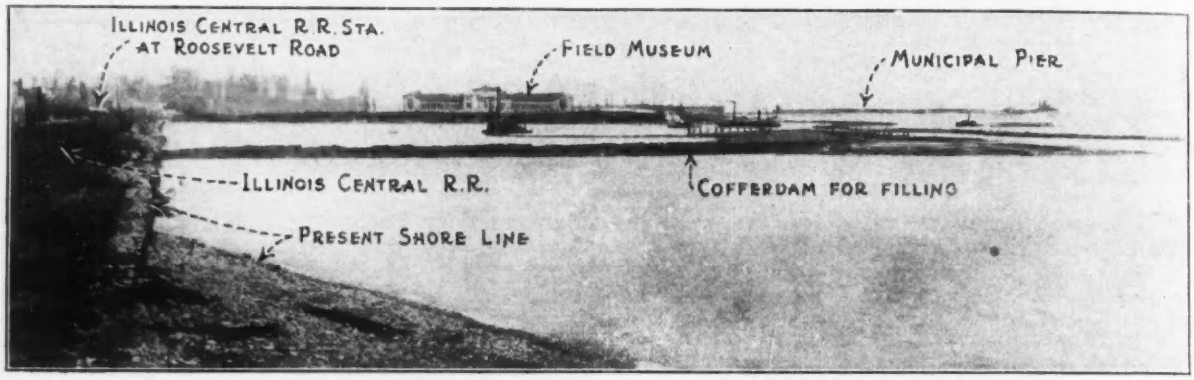


FIG. 2—SUCTION DREDGES MAKING DAM FOR LAKE FRONT FILL OF ILLINOIS CENTRAL R.R. AT CHICAGO

View looking north, with dam at 23rd St. The enclosed space will be used by the railway as a dump for the excavated material which is being taken from track depression work.

3. Extensive sewer construction is made necessary by the track depression. The smaller sewers range from 1 ft. to 6 ft. in diameter and now connect with a 16-ft. sewer in the right-of-way, which latter discharges into a 20-ft. intercepting sewer on 39th St. It was considered preferable to rebuild the sewers outside of the right-of-way rather than to lower them. Part of this work is being done by the Mortimer & Lindstrom Co. The 20-ft. sewer will have to be strengthened where the railway crosses it. A heavy piece of work now being done by the Underground Construction Co. is a 7-ft. brick sewer for four blocks in Rhodes Ave., with a connection to the 20-ft. interceptor. This involves a trench 24-ft. deep, sheeted and pumped, the work being complicated by a large inflow of water and the existence of a network of public utilities. Further, the connection with the 20-ft. sewer offers difficulties, since this

sewer extends from a pumping station at the lake shore, so that it runs full and under pressure.

4. Rearrangement of tracks will be carried out on a large scale and existing grade crossings with other railways at 67th St., Burnside, Kensington, Blue Island Junction, Riverdale, Harvey and Matteson will be eliminated by track elevation. As far as Kensington there will be thirteen tracks instead of eight as at present. North of 47th St. there will be six suburban, four through passenger and five freight tracks, while south of that point there will be four suburban, four through passenger and five freight tracks. From Kensington to Harvey there will be two suburban, two through passenger and five freight tracks, and from Harvey to Matteson there will be two tracks each for the three kinds of service.

5. Suburban station facilities will be enlarged materially and the Randolph St. terminal will be lengthened by extending it north to a new headhouse at South Water St.

6. A fine new passenger terminal station will be built fronting on the south side of Roosevelt Road, the present station being torn down as it lies in the way of extending this thoroughfare to the lake front. Tentative plans provide for three track levels. A stub-end terminal on the upper floor; baggage, mail and express tracks and facilities next, and through passenger and suburban tracks below. Definite plans for the track layout and station building will depend somewhat upon the number of tenant roads.

All these works are being planned and carried out under the direction of D. J. Brumley, chief engineer of Chicago terminal improvements, Illinois Central R.R.

Complications of Transportation on Western Power Job

Good Highways Through Mountains First Built and Then Heavy Material Brought in by Tractors and Trucks

TRANSPORTATION of materials and equipment into remote sites is the most serious problem connected with Western water power projects which for the most part are located in mountainous country far removed from railroads and good roads. The methods used on the Kerckhoff project of the San Joaquin Light and Power Corporation give some idea of the magnitude of this transportation task.

The development is located on the San Joaquin River 48 miles northeast of Fresno, Calif., and four miles from the nearest railroad point at Auberry, where the San Joaquin & Eastern Ry. has terminal facilities. The first party of construction engineers to move in on the job, found only wilderness between Auberry and the dam site. Without so much as running a line to determine the levels, teams were put to work on a road over the mountains, plowing and grading behind pioneers, who cut away the timber and blasted the rock. Sixty days' work brought the road to the canyon side, where a clearing was made for a supply dump and hoist house. A power line run parallel to the road and tapped at points, furnished power to operate a portable air compressor, which was used in drilling rock where blasting was necessary. The four miles of road built between the Kerckhoff dam and Auberry winds around mountains and skirts ravines, ending on the brink of the San Joaquin River Canyon at a point 1,100 ft. above the river bed and half a mile from the big construction work.

With a road completed to the canyon side, the next job was to get materials and men down the 1,100 ft. to the dam site. The plans called for a 3,700-ft. incline cable tram, the construction of which would require several weeks' time. Speed was required, as the time was limited for the construction of the project. It was decided to begin operations at once on the foundation while the construction of the incline cableway was in progress. Both skill and daring were required in

TRACTOR-TRAILER TRAIN HAULING TRANSFORMERS

the work of transporting materials down a mountain side having grades of 100 per cent, yet this feat stands out as a prominent factor that made possible the completion of the Kerckhoff dam in seven months' time.

Diamond drills, air compressors, and camp supplies for 100 men were lowered by means of sleds built up of lumber that was later used in construction work. These sleds were drawn by mules and snubbed from the rear by lines hitched to trees along the pathway. Timbers for a bridge 300 ft. in length and 65 ft. high, and compressor units weighing 14,000 lb., were let down the canyon sides in this way.

With the opening of over four miles of mountain road and the installation of the tramway and hoist, the movement of materials began in earnest. While the road was cut out of the side of the mountain, and it was passable, it was far from completed and required a large crew of men to get it into shape for the heavy trucks carrying cement, lumber and machinery. The material for the dam was hauled with three 5-ton and seven 2-ton trucks, operating constantly under the urgent need to make all speed possible. These trucks cut the roadway into deep ruts that were smoothed out as quickly as it was possible to work men and road machinery between trips and at night. The road was sprinkled at night. Water for the sprinkling and also to supply the main camp at Auberry was pumped from the San Joaquin River through a three-pipe line laid along the new road.

All hauling was done during the day, while two trucks equipped with sprinklers operated at night. Materials were delivered at the end of the road to the head of the incline, where platforms were built for storage, so

that trucks would not be held up waiting for the incline cars.

As material was delivered to the foot of the incline, it was placed at points where needed on the dam by means of two cableways anchored across the canyon, each having a capacity of ten tons. They were so arranged that a complete load on the incline car could be picked up and delivered to any part of the work.

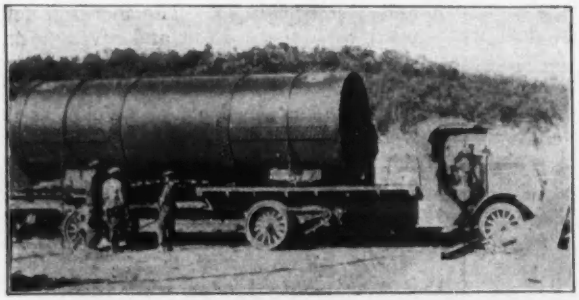
The work of loading the trucks at Auberry was handled by cranes placed conveniently near sidings and storage platforms. The materials were kept moving constantly toward the job as rapidly as the construction crews could handle them, and no opportunity was lost to load direct from the car to trucks, thereby eliminating as much handling as possible.

An additional nine miles of road was constructed to points of approach for tunnel adits and to reach the power house camp. These roads were of the same character as required for the dam construction with the advantage of a down-grade haul for 90 per cent of the distance. The maximum up-grade to the power house camp is 6 per cent, while the maximum down-grade is 12 per cent. The road to the power house was kept in condition by sprinkling and dragging with a curved edge drag to give a slight crown to the road.

The heaviest pieces hauled were the generator rotors, weighing 29 tons each. These were transferred from the car to the 30-ton trailer and hauled by the 75-hp. caterpillar to the power house, requiring a half day's time for each piece. Cement was also hauled on 10-ton trailers loading three in a train behind the caterpillar. At one time six transformer tanks were hauled in one train of six trailers. During the rush hours of completing the big job, one thousand tons of material were hauled in seven days from Auberry to the power house.

The cost per ton-mile for hauling with trucks was 31 cents to 35 cents, as against about 16 cents by tractor. The element of speed, however, made necessary the more rapid truck transportation wherever possible.

The power house is located in a box canyon, and 400 ft. below the only available space which could be used for storage. It was, therefore, necessary to install an incline railway for transportation from storage yard to power house site. This incline was 1,000 ft. long and had a maximum grade of 100 per cent as it entered the building. A ¾-in. cable was used and hoist equipped with 150-hp. slip-ring induction motor. A 15-ton derrick was installed between the track and road for transferring material and equipment from trucks and trailers to the incline cars.



SPECIAL TRAILER DESIGNED TO HANDLE 30-FT. LENGTH OF PENSTOCK

MAKING A MOUNTAIN ROAD TO CARRY MATERIAL TO HYDRO-ELECTRIC PLANT

The heaviest units entering into the development were taken over this power house road by means of a 75-hp. Holt caterpillar, drawing a 30-ton four-wheel trailer. The road stood up well under heavy loads of 29 tons. Lighter loads were handled by trucks and by means of 10-ton trailers. Additional transportation equipment was placed on the work as required until the peak of the load required the following:

1—75-hp. Holt caterpillar
1—45-hp. Holt caterpillar
1—30-ton trailer
6—10-ton trailers
2—15-ton horse-drawn wagons
4—5-ton two-wheel trailers
3—5-ton Mack trucks
1—5-ton Pierce-Arrow truck
1—5-ton White truck
1—2-ton Mack truck
4—2-ton White trucks
2—Dodge commercial cars
9—Light service cars

Cement was the most important material to be transported because of the constant need for it, and the great aggregate weight of the material required. Lumber was a close second in tonnage hauled, averaging four pounds to the board foot because of the large content of moisture in the green lumber, most of which came direct from the sawmills.

A summary of the total tonnage hauled for the Kerckhoff development, exclusive of the transportation of men and the work of light service cars, shows the following:

Cement 161,623 sacks	8,081 tons
Rail	646 tons
Lumber, 3,818,200 ft.	7,636 tons
Explosives 1,280,300 lb.	640 tons
Equipment and supplies, 9,911,902 lb.	4,956 tons
Power house equipment	329 tons
Penstock	709 tons
Subsistence	1,622 tons
Salvage haul of equipment, rails, pipe, lumber and supplies	3,196 tons
	27,815 tons

The work was carried out under the direction of Rex C. Starr, then construction engineer of the company, who supplied the material from which this article was prepared.

Rules for Rivet-Hole Deductions in Tension Members

Simple Formulas for Equal-Stress and Equal-Area Methods Derived—How They Compare in Practical Application

BY VICTOR H. COCHRANE
Consulting Engineer, Tulsa, Okla.

THERE has recently been considerable discussion in regard to the proper deductions for staggered rivet holes in tension members, but it appears that no satisfactory conclusions have been reached. The writer desires to make some further observations on the subject, in the hope that the definite and simple working rules proposed herein may aid in securing general acceptance of the method of fractional deductions.

The so-called theoretical method of allowing for the effect of staggered rivets, proposed by the writer in *Engineering News* of April 23, 1908, p. 465, assumes in effect that transverse and zigzag sections are equal in strength when the maximum tension, considering the effect of shear, is the same in both sections (equal-stress method). Another rule in common use assumes the equality of strength when the transverse and zigzag sections are of equal area (equal-area method). The former requires the greater stagger for equal deductions.

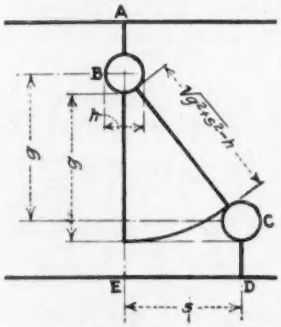


FIG. 1—MINIMUM STAGGER OF RIVET HOLES

There has been some controversy as to whether the equal-stress method is in accordance with experimental results. Edward Godfrey, in your issue of Aug. 31, 1922, p. 366, contends that this rule gives excessively large deductions, and that tests made by him prove the correctness of the equal-area rule. These claims are controverted by Prof. C. R. Young in your issue of Sept. 21, 1922. It seems worth while therefore to show by examples just what the difference in the two rules amounts to, expressed in percentages of the gross section.

Whichever of these two rules may be considered correct, there is no question as to the desirability of making fractional rivet hole deductions when the stagger is less than that required for zero deduction. It will be shown that this can be done with equal facility by either method; a simple formula can be written in either case, a single diagram will suffice for any and all sizes of rivets, and if desired the deductions may be found by a simple graphical method.

Consider first the equal-area rule. In Fig. 1 the net section along the diagonal is $\sqrt{g^2 + s^2} - h$, in which g is the gage, s the stagger and h diameter of rivet holes. If the net area of the transverse section *ABE* is equal to that of the diagonal section *ABCD*, it is evident that this quantity must be equal to g, whence

$$s = \sqrt{2gh + h^2} \qquad (1)$$

This is the well-known formula given in handbooks to show the relation between s and g required to maintain net section. On the basis of the fractional-hole method of computing the allowance for staggered rivets, as advocated by T. A. Smith and Professor Young, the value of s given by Eq. (1) is that value for which no deduction from the transverse section is to be made.

It can be shown that under the equal-stress hypothesis Eq. (1) gives that value of s for which the deduction is half of a rivet hole, instead of zero as in the case of the equal-area rule.

Let w be the width of strip to be deducted from the transverse section on account of a staggered rivet hole. It is evident that when s is equal to zero, the width w is equal to h. As s increases, w decreases, slowly at first and then more rapidly. It seems reasonable to assume that the decrement of w, as s increases, varies as the square of s, hence we may write

$$w = h - cs^2, \qquad (2)$$

in which c is a constant.

Therefore if in accordance with the above assumption we substitute $h/2$ for w and $\sqrt{2gh + h^2}$ for s in Eq. (2), we obtain the equation

$$\frac{h}{2} - h/3 = h - c\,(2gh + h^2),$$

whence

$$c = \frac{1}{4g + 2h}$$

and

$$w = h - \frac{s^2}{4g + 2h}$$

Since the term $2h$ in the denominator is comparatively small we may for practical purposes simplify the above formula by omitting it, thus reducing the equation to

$$w = h - \frac{s^2}{4g} \qquad (3)$$

This formula gives the width to be deducted on account of a staggered rivet and it is recommended for practical use. Although much simpler than Professor Young's formula, or the substitute therefor proposed by the writer in your issue of July 6, 1922, it gives results in remarkably close agreement with the so-called theoretical formula as derived by Professor Young.

Proceeding in a similar manner the equal-area rule gives the following formula for fractional deductions:

$$w = h - \frac{s^2}{2g + h}$$

Substituting for h in the denominator of the last term an average value of 1, we have

$$w = h - \frac{s^2}{2g + 1} \qquad (4)$$

This is the formula proposed for use in making fractional deductions by the equal-area rule.

Comparing equations (3) and (4), it will be seen that they give practically the same deductions for small values of s; but as s increases, the negative term increases almost twice as fast in the equal-area formula as in the equal-stress formula. Either formula will give consistent results. The maximum difference in the deduction for one hole by the two formulas is nearly half a rivet hole, but it will usually be less than this.

The width w to be deducted in any case can be determined by a simple graphical method. Thus in Fig. 2 the shaded strip w, is the deduction for the rivet having

that trucks would not be held up waiting for the incline cars.

As material was delivered to the foot of the incline, it was placed at points where needed on the dam by means of two cableways anchored across the canyon, each having a capacity of ten tons. They were so arranged that a complete load on the incline car could be picked up and delivered to any part of the work.

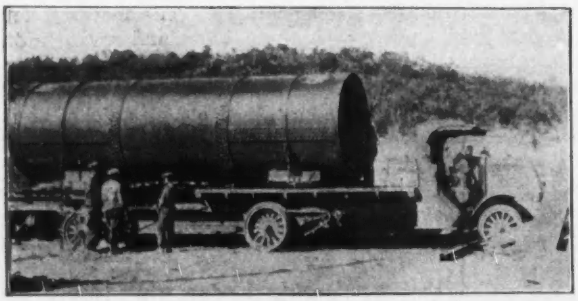
The work of loading the trucks at Auberry was handled by cranes placed conveniently near sidings and storage platforms. The materials were kept moving constantly toward the job as rapidly as the construction crews could handle them, and no opportunity was lost to load direct from the car to trucks, thereby eliminating as much handling as possible.

An additional nine miles of road was construct to points of approach for tunnel adits and to reach t power house camp. These roads were of the same ch acter as required for the dam construction with t advantage of a down-grade haul for 90 per cent of t distance. The maximum up-grade to the power hou camp is 6 per cent, while the maximum down-grade 12 per cent. The road to the power house was kept condition by sprinkling and dragging with a curv edge drag to give a slight crown to the road.

The heaviest pieces hauled were the generator rotc weighing 29 tons each. These were transferred fr the car to the 30-ton trailer and hauled by the 75- caterpillar to the power house, requiring a half da time for each piece. Cement was also hauled on 10- trailers loading three in a train behind the caterpill At one time six transformer tanks were hauled in train of six trailers. During the rush hours of co pleting the big job, one thousand tons of material w hauled in seven days from Auberry to the pow house.

The cost per ton-mile for hauling with trucks v 31 cents to 35 cents, as against about 16 cents tractor. The element of speed, however, made nec sary the more rapid truck transportation where possible.

The power house is located in a box canyon, and ft. below the only available space which could be u for storage. It was, therefore, necessary to install incline railway for transportation from storage y to power house site. This incline was 1,000 ft. long and had a maximum grade of 100 per cent as it entered the building. A ¾-in. cable was used and hoist equipped with 150-hp. slip-ring induction motor. A 15-ton derrick was installed between the track and road for



SPECIAL TRAILER DESIGNED TO HANDLE 30-FT. LENGTH OF PENSTOCK

PAG
MISS

four joints of the main line before it entered the [illegible] content of moisture in the green lumber, most of which came direct from the sawmills.

A summary of the total tonnage hauled for the Kerckhoff development, exclusive of the transportation of men and the work of light service cars, shows the following:

Cement 161,623 sacks	8,081 tons
Rail	646 tons
Lumber, 3,818,200 ft.	7,636 tons
Explosives 1,280,300 lb.	640 tons
Equipment and supplies, 9,911,902 lb.	4,956 tons
Power house equipment	329 tons
Penstock	709 tons
Subsistence	1,622 tons
Salvage haul of equipment, rails, pipe, lumber and supplies	3,196 tons
	27,815 tons

The work was carried out under the direction of Rex C. Starr, then construction engineer of the company, who supplied the material from which this article was prepared.

Rules for Rivet-Hole Deductions in Tension Members

Simple Formulas for Equal-Stress and Equal-Area Methods Derived—How They Compare in Practical Application

BY VICTOR H. COCHRANE
Consulting Engineer, Tulsa, Okla.

THERE has recently been considerable discussion in regard to the proper deductions for staggered rivet holes in tension members, but it appears that no satisfactory conclusions have been reached. The writer desires to make some further observations on the subject, in the hope that the definite and simple working rules proposed herein may aid in securing general acceptance of the method of fractional deductions.

[illegible]GES

[illegible]SING

[illegible]rect, there is no question as to [illegible]ing fractional rivet hole deductions when the stagger is less than that required for zero deduction. It will be shown that this can be done with equal facility by either method; a simple formula can be written in either case, a single diagram will suffice for any and all sizes of rivets, and if desired the deductions may be found by a simple graphical method.

Consider first the equal-area rule. In Fig. 1 the net section along the diagonal is $\sqrt{g^2 + s^2} - h$, in which g is the gage, s the stagger and h diameter of rivet holes. If the net area of the transverse section *ABE* is equal to that of the diagonal section *ABCD*, it is evident that this quantity must be equal to g, whence

$$s = \sqrt{2gh + h^2} \qquad (1)$$

This is the well-known formula given in handbooks to show the relation between s and g required to maintain net section. On the basis of the fractional-hole method of computing the allowance for staggered rivets, as advocated by T. A. Smith and Professor Young, the value of s given by Eq. (1) is that value for which no deduction from the transverse section is to be made.

It can be shown that under the equal-stress hypothesis Eq. (1) gives that value of s for which the deduction is half of a rivet hole, instead of zero as in the case of the equal-area rule.

Let w be the width of strip to be deducted from the transverse section on account of a staggered rivet hole. It is evident that when s is equal to zero, the width w is equal to h. As s increases, w decreases, slowly at first and then more rapidly. It seems reasonable to assume that the decrement of w, as s increases, varies as the square of s, hence we may write

$$w = h - cs^2, \qquad (2)$$

in which c is a constant.

[illegible]e if in accordance with the above assumption [illegible]ıte $h/2$ for w and $\sqrt{2gh + h^2}$ for s in Eq. (2), the equation

$$h/3 = h - c\,(2gh + h^2),$$

$$c = \frac{1}{4g + 2h}$$

$$w = h - \frac{s^2}{4g + 2h}$$

[illegible]e term $2h$ in the denominator is comparatively [illegible]may for practical purposes simplify the above [illegible]y omitting it, thus reducing the equation to

$$w = h - \frac{s^2}{4g} \qquad (3)$$

[illegible]rmula gives the width to be deducted on ac- [illegible]a staggered rivet and it is recommended for [illegible]use. Although much simpler than Professor [illegible]formula, or the substitute therefor proposed [illegible]riter in your issue of July 6, 1922, it gives [illegible]a remarkably close agreement with the so- [illegible]eoretical formula as derived by Professor

[illegible]ding in a similar manner the equal-area rule [illegible]e following formula for fractional deduc-

$$w = h - \frac{s^2}{2g + h}$$

Substituting for h in the denominator of the last term an average value of 1, we have

$$w = h - \frac{s^2}{2g + 1} \qquad (4)$$

This is the formula proposed for use in making fractional deductions by the equal-area rule.

Comparing equations (3) and (4), it will be seen that they give practically the same deductions for small values of s; but as s increases, the negative term increases almost twice as fast in the equal-area formula as in the equal-stress formula. Either formula will give consistent results. The maximum difference in the deduction for one hole by the two formulas is nearly half a rivet hole, but it will usually be less than this.

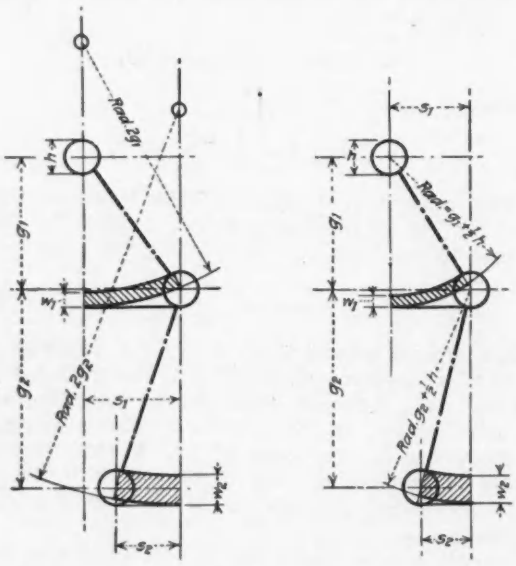
The width w to be deducted in any case can be determined by a simple graphical method. Thus in Fig. 2 the shaded strip w, is the deduction for the rivet having

stagger s_1 and gage g_1. The width w_1 is that portion of the diameter h intercepted by an arc of radius $2g_1$ in the position shown. Fig. 3 shows a similar construction for the equal-area method, the arc being concentric with the last rivet and having a radius equal to $g + \frac{1}{2}h$.

A single diagram giving values of the last term of formula (3) or (4), the decrement of h, will suffice for any diameter of rivet, thus making the method of fractional deductions more convenient in practical use than if a separate diagram were required for each size of rivet.

Some examples will now be given showing the difference in net section by the two rules, using equations (3) and (4) to compute the deductions.

First take the case of a 12 x ½-in. plate having two rivet holes on a transverse line, located 1½ in. from each edge, with a staggered rivet on the center line. Assuming ⅞-in. rivets, h is equal to 1. The gage g is equal to 4.5 in. The maximum deduction along the



FIGS. 2 AND 3—RIVET-HOLE DEDUCTIONS BY GRAPHICS

transverse line = $2h$ = 2. The following table shows the deductions along the zigzag line through the staggered hole for various staggers; also the difference in net areas expressed as percentages of the gross area:

Stagger s in Inches	Deductions Along Zigzag Line Computed by Equal-Stress Formula	Deductions Along Zigzag Line Computed by Equal-Area Formula	Maximum Deductions By Equal-Stress Method	Maximum Deductions By Equal-Area Method	Differences Width in Inches	Differences Per Cent Of Gross Width
1.0	0.94	0.90	2.88*	2.80	0.08	0.6
1.5	0.87	0.78	2.74	2.56	0.18	1.5
2.0	0.78	0.60	2.56	2.20	0.36	3.0
2.25	0.72	0.49	2.44	2.00	0.44	3.7
2.5	0.65	0.38	2.30	2.00	0.30	2.5
3.0	0.50	0.10	2.00	2.00	.....	.....
3.5	0.18	0.00	2.00	2.00	.....	.....
4.0	0.11	0.00	2.00	2.00	.....	.....

* 1.00 + 0.94 + 0.94 = 2.88

In this case the maximum difference is 3.7 per cent of the gross section.

Consider now the built-up section shown in Fig. 4. By the equal-stress formula (3) the net section is computed thus:

	Gage g	Stagger s		
Angles,	4½	1½	(2 x 1⅛—0.13) x ½ x 4	4.24 sq.in.
30 in. x ¾ in. plates, and or	First hole	1⅛—0	1.125	
	2	3	do.—1⅛	
	3¼	3	do.—0.69	
	5¼	0	do.—0	1.125
	5	3	do.—0.45	0.675
	5	0	do.—0	1.125
	5	3	do.—0.45	0.675
	5¼	0	do.—0	1.125
			5.850 x ¾ x 2	8.78 sq.in.
18 in. x ½ in. plates			3.60 x ½ x 2	3.60 sq.in.
Total deductions				16.62 sq.in.

Net section, 82.0—16.62 = 65.38 sq.in.

By the equal-area formula (4) the deductions are as follows:

Angles	4.04 sq.in.
30-in. plates	7.66 sq.in.
18-in. plates	2.86 sq.in.
Total	14.56 sq.in.
Net section	67.44 sq.in.

Hence the difference in net section as computed by the two formulas is 2.06 sq.in., or 2½ per cent of the gross section.

The equal-area rule as generally applied requires no deduction if the stagger is as great as $\sqrt{h^2 + 2gh}$, but for any lesser stagger a full hole must be deducted. On this basis the deduction would be as follows:

Angles, 8 holes out	4.50 sq.in.
30-in. plates, 12 holes out	10.12 sq.in.
18-in. plates, 8 holes out	4.50 sq.in.
Total	19.12 sq.in.

This is a greater deduction than that obtained by either of the fractional-deduction formulas. This shows the importance of making fractional deductions rather than counting out the entire hole or none.

The differences in results by formulas (3) and (4) are so small that there seems to be no prospect of conclusively establishing by experiment the correctness of

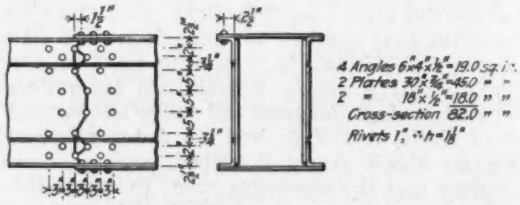


FIG. 4—BUILT MEMBER—A COMPLEX CASE OF COMPUTING NET SECTION

either formula as compared with the other. The equal-stress rule is preferred by the writer because it has some theoretical basis and is somewhat more conservative than the equal-area rule. On the other hand it requires much less reduction of area, or much smaller staggers for the same reduction, than does the common rule requiring 30 per cent excess diagonal area for equal transverse and diagonal strength.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A Notable Work on Tunneling

BY CLIFFORD M. HOLLAND
Chief Engineer, New York-New Jersey Vehicle Tunnel Commissions

SHIELD AND COMPRESSED AIR TUNNELING—By B. H. M. Hewett, M. Am. Soc. C. E., M. Inst. C. E., Director, Jacobs & Davies, Inc., New York, Consulting Engineers, sometime engineer on the construction of the Central London Railway, of extensions to the City & South London Railway, of the Hudson River Tunnels for the Pennsylvania R.R., New York, and of the Laxaxalpam Aqueduct Tunnels for the Mexican Light & Power Co., in the State of Puebla, Mexico; and S. Johannesson, M. Am. Soc. C. E., sometime engineer on the construction of the Islington extension to the City & South London Railway, of the Pennsylvania Railroad Tunnels, New York, and of the Manhattan Elevated Railroad improvements and extensions for the Interborough Rapid Transit Co., New York. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 465. $5.

"Shield and Compressed Air Tunneling" deals with the difficult work of tunneling through soft or water-bearing ground by the use of the shield with or without compressed air. The authors are qualified by years of experience on this sort of work to handle the subject adequately, and they are to be congratulated both as to the plan and scope of the book and on their close adherence to their subject. They have amplified many points in regard to which information heretofore has been meager, and have endeavored to put shield tunneling on a "rational" basis and to eliminate as far as possible the many indeterminate factors that enter into tunnel design and construction. The volume presents many details of tunnel construction which up to the present time have been entirely omitted from the books on this subject. The text is very clear; the thoughts of the writers come easily, and the diction is unusually good; numbered paragraphs in bold face captions make the book easy for reference.

The first few chapters have to do with the general subject of tunneling, in which is included a condensed history of shield-driven tunnels. Here the reader can obtain at a glance a brief summary of each tunnel, which can be amplified, if he is sufficiently interested by reference to the entries in the bibliography at the end of the book. This feature alone makes the book invaluable to the tunnel engineer.

The description of the mining operations involved in driving a timbered heading is very clear and should give the neophyte a ready grasp of the detail operations. The American and English timbering systems are described without unduly complicating the subject. The systems described are typical and sufficient for the information of the reader. The discussion of the size and shape of tunnels is noteworthy. A folder gives at a glance the cross sections and profiles of many tunnels.

The treatment of the design of tunnel linings introduces much new matter which has not previously been available. A number of points have been raised with which all will not agree. The presentation of the theory used in the development of the formulas suffers from the same ailment that has affected many other books of similar character; that is, the authors take too much for granted in assuming that their readers are able to follow their discussion. It would be far better to omit the development of equations for determining bending moments and thrusts than to present it in such fashion that the reader becomes hopelessly puzzled and must go elsewhere for explanation. Such developments should be given in their entirety or not at all. The endeavor to wade through an incomplete presentation, hunting for clues to pick up the thread of its development, not only irritates the reader, but beclouds the question.

The authors assume as a basis for determining the external loads on the tunnel lining the full hydrostatic pressure with the submerged weight of the heavier material. The case might arise in which the material might not be pervious, in which event its full weight should be taken and the water superimposed. This will not affect pressures acting vertically, but it will affect the horizontal thrusts, according to Rankine's theory of earth pressures, which they use. For example, the first case would apply more nearly to the material under the East River, while the second case probably would apply more nearly to the Hudson River silt. The second case would give larger bending moments in the structure, depths and angles of repose remaining the same in each case. The authors state that limiting values of pressures have been used whenever the uncertainties of earth pressures have not permitted a definite value to be assigned. Where is there any certainty of earth pressures in tunneling?

The design of a tunnel lining is very largely empirical, due to the uncertainty of loading both during and after construction. The authors have recognized this, but they very properly have emphasized the value of theoretical analyses based on various assumed loadings. These may never be realized in practice, yet they serve as a useful guide to obtain a consistent design.

There are many points raised in connection with the design of tunnel linings with which the reviewer is not in agreement; for example, in discussing the unit stress in bolts, the authors state that the use of steel with high elastic limit does not decrease the elongation, because the modulus of elasticity is about the same for all grades of steel. They argue, therefore, that in order to keep the elongation of bolts and the deformation of the lining as small as possible, the maximum stress in the bolts should be kept low.

It should be remembered that the function of the tunnel bolts is twofold: first, the bolts are used to draw the segments together so that the iron may be built to a true circle, and, second, the bolts resist the tendency of the ring to deform. The higher the initial stress in bolting, the less will be the allowable stress to resist deformation. If a low carbon steel is used, say with an initial stress due to the bolting of 5,000 lb., the distortion will be uniform up to an elastic limit say of 30,000 lb. Now, in the case of a high elastic-limit steel, say with an elastic limit of 80,000 lb., there is an ample margin for distortion even though the initial bolting stress is 30,000 lb. The use of high-tensile steel for the bolts, with a consequent reduction in diameter, permits of placing them more advantageously in the end flange and permits an initial tightening of the bolts far in excess of anything possible with low-tensile steel. The more advantageous location of the

bolts and the higher initial bolt tightening materially reduce the final stresses in the cast iron, so that aside from the resulting saving in cost there are other decided advantages in the use of bolts with a high elastic limit.

Recent experience in cast-iron tunnel building has emphasized the necessity of strong joints, due to the fact that as the iron leaves the shield it is subjected to eccentric loadings and conditions which cannot be predetermined or definitely provided for in design. In general, the application of formulas given in the book for arriving at the bolt stresses as well as the moments and thrusts in the tunnel lining produces results that diverge widely from those obtained in the detail investigations of the lining for the design of the Hudson River Vehicular Tunnel. One might gain the impression from reading the chapter on design that a subaqueous tunnel may be directly and completely designed by the application of a few formulas.

Considerable space is devoted to tunnel plant and construction, which is extemely well handled and of value to the construction engineer. The data in regard to tunnel costs are of necessity meager, and can be taken only as an indication of relative costs under similar conditions on similar work.

The chapter on surveys contains much of value to the young engineer because of its many valuable lessons in precise surveying. Some of the methods described appear to be unduly complicated, but there is no question as to their giving correct results. The practice during recent years has been to simplify; for example, the method described in the book for throwing lines through a tunnel lock was not used on any of the rapid-transit tunnels under the East River. There the transit was always set up in the lock and ranged into line, the nearer point being immediately outside the lock and just within the focal distance of the transit. This, however, is a mere detail in survey work and is simply another way of accomplishing the same thing. The chapter on surveys is the best presentation of this subject that has yet come to the writer's attention.

The discussion of compressed-air illness contains the latest data on this subject. The great fund of information given in small space is sufficient for the purposes of the engineer. If the reader seeks more, he can refer to the medical and other works listed in the bibliography.

Altogether Messrs. Hewett and Johannesson have rendered a service of great value to the tunnel-building profession. The young engineer will find the book of particular value, for by a careful study of its contents he will acquire a fundamental knowledge of many phases of the work hitherto known only to the experienced engineer.

A Notable Regional Planning Survey

SOUTH WALES REGIONAL SURVEY COMMITTEE: Report to Ministry of Health—[Among others on the committee were Patrick Abercrombie, Professor of Town-Planning and Civic Design, University of Liverpool; D. M. Jenkins, Assoc. M. Inst. C. E., Borough Engineer of Leath; E. H. Swain, Assoc. M. Inst. M. E., Transport Commissioner for Wales. Edgar L. Chappell, of the Ministry of Health, was secretary.] London: H. M. Stationery Office. Paper; 6 x 9 in.; pp. 80; 3 folding maps. 3s. 8½d. postpaid.

The committee mentioned above was created in 1920 to report on "the distribution and location of the houses to be built with State aid" in the South Wales coal fields, with regard to: The "health and convenience of the industrial population"; the physical and industrial conditions of the region and its probable future development; and transit facilities, water supply, sewerage and like services. All these things are considered in a broad and enlightened way. Among the recommendations made are: Location of future housing accommodations in groups, away from the collieries, with a fast train service between housing areas and industrial centers; new arterial roads, carefully planned; readjustment of "local authority boundaries"; a regional water-supply board to supply water in bulk to local authorities; valley trunk sewers with ocean outfalls; linking up of gas and electric supplies; division of whole region into four joint town-planning districts, under supervision of a single regional town-planning board; a regional council similar to the London County Council. Recreational spaces, garden allotment areas, the development of Portcawl as a health center, bathing facilities at colliery mouths and steps to diminish river pollution are also advised.

Among the representatives of 22 local governing bodies examined as witnesses by the committee there were 20 engineers.

Electric Traction for Trunk Lines

RAILWAY ELECTRIC TRACTION—By F. W. Carter, M.A. M. Inst. C.E., M.I.E.E., Assoc. A.I.E.E. New York: Longmans, Green & Co. London: Edward Arnold & Co. Cloth; 6x9 in.; pp. 412. $8.50 net.

This is a textbook on electric traction for trunk line railways, directed especially to the electrical engineer, but nevertheless handling in helpful fashion some of the problems of electrification that concern construction, maintenance and operation. The author has set himself a two-fold task: First, to discuss the methods of electric traction as applied to railways, and second, to expound methods of technical calculation applicable to the subject.

After an introductory review of the state of the art, in the course of which American experience has been freely drawn upon, Mr. Carter takes up the design and characteristics of electric locomotives. The conventional description of types has been supplemented by mathematical treatment of many of the fundamental problems involved in the design of running gear and in determining the forces brought to bear on the track. Next are taken up the electrical and mechanical characteristics of the various types of railway motors, together with a discussion of their performance in service and of the several systems of control.

Under "Distribution System" are discussed the questions of type of conductor, electrolysis, boosters, sectionalizing, collector-gear, and interference with neighboring conductors. The generating station is treated briefly while the substation is considered at length. Considerable attention is given to the mercury vapor rectifier and the automatic substation. In his chapter on "Systems of Electrification" Mr. Carter reveals himself as an out-and-out champion of direct current as opposed to alternating current, and the latter is discussed mainly to recount its deficiencies.

A large section of the book is devoted to the mechanics of train driving, with analyses of tests that have been conducted both in Europe and in the United States to determine tractive resistance. These are discussed exhaustively and methods are developed to estimate energy consumption and motor heating under given tractive conditions. Mr. Carter also offers calculation to determine the performance of a given train with stated motor equipment to ascertain the most suitable

equipment for a particular service. In an appendix the book gives detailed characteristics and dimensions of thirty-two electric locomotives that have been in operation in England, on the continent and in the United States.

For the engineer who is willing to dig into basic principles and to study mathematically the fundamental problems of railroad electrification, Mr. Carter's book will be helpful and stimulating. It is in refreshing contrast with the many books that confine themselves to a purely descriptive treatment.

Principles of Architectural Drafting

ARCHITECTURAL DRAWING—By Wooster Bard Field, Architect, Assistant Professor of Engineering Drawing, The Ohio State University; With an Introduction and Article on Lettering by Thomas E. French, Professor of Engineering Drawing, The Ohio State University. New York and London: McGraw-Hill Book Co. Cloth; 10 x 12 in.; pp. 161; illustrated. $4.

The smallest engineering office and every engineering draftsmen have to make architectural drawings now and then. To such this volume will be useful for reference or self-instruction, besides serving its primary purpose in school and college work. The book will have all the stronger appeal to engineers because it has been prepared by professors of engineering drawing in one of our large universities.

Commendable is the mode of approach. The first plate and text show simply and clearly "the two general methods of representing an object having three dimensions on a sheet of paper which has only two dimensions"—(1) pictorial drawing, including (a) perspective, (b) isometric and (c) oblique drawings, and (2) orthographic projection. From this the work continues with instruments, geometric methods, preliminary sketches (which include pictorial drawing, shades and shadows and rendering), scale and detail drawing, the orders of architecture, the acanthus leaf and lettering. The latter includes inscriptions for tablets, monuments, etc., a matter of occasional importance to engineers, although as a rule best entrusted by them to some specialist where rendering in harmony with other artistic elements of design is essential.

Useful for those who wish to pursue the subject by themselves is an Outline of Study, while for those who wish to go still further there is a classified list of reference books. A glossary and an index complete the volume.

Omissions from the reference list that seem to call for explanation are "The American Civil Engineer's Handbook" (other such books are listed) and Reinhardt's "Lettering." A book dealing with drawing for reproduction, or a reference to a section on this subject in some of the books listed, might well have been given. In fact, this subject deserves more than an entry in the Bibliography even if no more than to call attention to the fact that a drawing made for reproduction should be made with that end in view and that the end may be easily accomplished by following a few simple rules, which could be outlined in a paragraph or two.

The lettering and the illustrations generally in the volume under review deserve praise. The only criticism we venture to make is the too extensive use of capital letters exclusively for long explanatory notes supplementary to the drawings. Where such notes are chiefly utilitarian in character, as they are in most instances in this book, both ease of reading and speed in draftsmanship are better served by the use of caps and lower case.

English for Engineering Students

REVIEWED BY C. W. PARK

Professor of English, College of Engineering and Commerce, University of Cincinnati

TECHNICAL EXPOSITION: A Textbook on the Application of Exposition to Technical Writing, Designed for Students in Scientific, Agricultural, and Engineering Colleges—By Karl Owen Thompson, A.M., Associate Professor of English at Case School of Applied Science, Cleveland, Ohio. New York and London: Harper & Brothers. Cloth; 5 x 8 in.; pp. 227. $1.75.

Professor Thompson's book is intended as a guide to the engineering or scientific student in the study and use of English. It is meant to be used as a textbook, and there is evidence throughout its pages that it has been developed and tested in the class room. This does not make the book devoid of interest to the general reader. For those who prefer to ignore the numerous exercises, there is profitable reading in the fifteen chapters of discussion, with their suggestive treatment of topics ranging from the history of language to the writing of specifications.

The author has chosen to treat much of his material broadly and abstractly, on the theory that specific examples are best obtained from current issues of technical periodicals. This view finds justification in the fact that numerous engineering colleges use such journals in the class room as a source of fresh illustrations and as an exemplification of standard practice in the presentation of technical matter. Perhaps out of a spirit of neutrality, the author has refrained from making reference to specific technical journals and has left his questions and exercises general. If there is any considerable defect or incompleteness in the book, it is in this respect. Without unduly lengthening the volume, the author might have cited concrete examples illustrating how journalistic matter drawn from such sources could most effectively be used as an accompaniment to the discussion of general principles. Where special types of writing are discussed, such as the business letter or the advertisement, the illustrations are adequate and effective.

In the main discussion there is much to commend this book both to the college student and to the older reader who wishes to "brush up" on his English by a process of self-instruction. From the standpoint of either, the book is a comprehensive review of the various types of scientific and practical writing and of the rules and principles most often used. As the title indicates, the discussion is limited to "Exposition," but since this form of composition is employed in every variety of technical writing, the range of the book does not suffer by reason of this limitation. The book covers the fundamentals of word study, grammar, punctuation and rhetoric, with emphasis upon definition and analysis. It deals with such types of exposition as translations, paraphrases, summaries, reviews, speeches, letters, articles, advertisements, reports, specifications, contracts, and statistics. The book itself is a good example of exposition. Especially when one considers the scope of its contents and the resulting necessity for a brief instead of a detailed discussion, one is impressed by the judicious selection of standard material covering each topic, and the clear, succinct manner in which the various topics are treated.

Mechanically, the book is well put together. One error in printing should be noted, since it confuses the identity of a man who has written a particularly useful book on English for engineers. The name at the bottom of page 92 should be "W. O. Sypherd" instead of "W. O. Shepherd."

A Field of Higher Mathematics

REVIEWED BY GEORGE PAASWELL
Construction Engineer, New York City

VECTOR CALCULUS WITH APPLICATIONS TO PHYSICS—By James Byrne Shaw, Professor of Mathematics in the University of Illinois. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 314; illustrated. $3.50 net.

This book treats of a mathematical method that is of growing importance to both pure and applied mathematics. It is essentially a text for graduate students of mathematics and proves to be a sincere attempt to render service in the solution of the many important problems of physical research.

For the student the arrangement of the contents seems to meet the requirements of good pedagogical practice. An excellent historical introduction is followed by both mathematical and physical definitions and includes many well-chosen problems. The author gives with clearness and with brevity the applications of vector analysis to geometry and to the study of the fields of force.

The treatment of quaternions effectively introduces the reader to Hamilton's brilliant conception. Aside from its practical importance, the method is exceedingly interesting reading for its originality. How our mathematical ancestors would marvel at the applications of the imaginary functions—termed by them the impossible quantities! The properties of space are placed in brief symbolic form and the theorems of spherical geometry and trigonometry are compacted into symbols with a simplicity that amazes one familiar with the usual school treatises.

Those interested in the theory of surfaces and hesitating to take up the existing treatises on differential geometry or on the more complex differential equations will find the vector calculus of readier comprehension in the application to such theory.

There is rather complete vector treatment of the mathematical theory of elasticity and of hydromechanics, subjects of enduring importance.

Vector calculus is exceedingly rich in its applications to electrical phenomena but lean in its applications to structural research. The civil engineer must bear the onus of the blame for this condition. His indifference to higher mathematics is proverbial. Nevertheless, the text could have proved of great service to engineers had it analyzed more fully the practical problems of elastic research and dilated in greater detail upon the simpler phases of the vector calculus, such as the study of force polygons, influence lines and the like. There are, again, complicated methods of frame analysis that should receive simpler treatment through use of the vector calculus. The nucleus of all such analysis is contained in the text, but there are few engineers with either the patience or the desire to expand such nuclei. It seems that all advances towards a liaison between engineering analysis and the higher mathematics must be made by the mathematician.

The text is not unreasonably difficult to follow for those mathematically interested, and aside from the practical import of the subject it constitutes an excellent discipline in forming pictures of space properties in a novel symbolism.

Those interested in the theory of general relativity will note with disappointment that no attempt has been made to discuss the tensor calculus of Einstein, nor is any mention made of the absolute calculus. This is all the more unfortunate since these studies remain buried in the proceedings of the foreign scientific societies.

Professor Shaw is to be congratulated upon the publication of so teachable a text, one that is certain to prove helpful to the student. The engineers who can bring themselves to the point of reading it will find much enjoyment and some profit.

Garden City Theory and Practice

TOWN THEORY AND PRACTICE—By W. R. Lethaby, George L. Pepler, Sir Theodore G. Chambers, K.B.E., Raymond Unwin, and R. L. Reiss. Edited with an Introduction by C. B. Purdom. London: Benn Brothers, Ltd. Cloth; 5 x 7 in.; pp. 139; maps. 5s net.

The fact that within two years all municipalities of 20,000 population and more in Great Britain must prepare "town plans" and the consequent desirability of stimulating and directing discussion "about towns and their planning" is given in Mr. Purdom's Introduction as a reason for publishing this book, which is designed "to appeal to the ordinary reader." Continuing he says: "For the purpose of definition the town idea which is implicit in the term 'garden city' has been employed as the basis of discussion."

A garden city, the collaborators agree, is a complete social and industrial municipal unit, including within its geographical limits not only parks but also a permanent agricultural belt, the whole carefully zoned [although that word is used rarely if at all in the book—there is no index] into use districts. Other essential features of the garden city are ownership of the entire area by or in trust for the community; local industries for all the residents and local residences for all the workers; and complete recreational, educational and other social facilities within the city limits. To increase these and the other features "implicit in the term 'garden city'" it is essential that the size of each garden city, both in area and population, be large enough but not too large to ensure a self-contained unit.

The subdivisions and authors are: "The Town Itself: A Garden City is a Town," by Mr. Lethaby; "The Town Plan—planned for industry and healthy living," by Mr. Pepler, president Town Planning Institute; "The Town and the Best Size for Good Social Life—of a size that makes possible a full measure of social life, but not larger," by Mr. Unwin, author of "Town Planning in Practice"; "The Town and Agriculture—surrounded by a permanent belt of rural land," by Mr. Chambers, chairman, Welwyn Garden City., Ltd.; "The Town and Land—the whole of the land being in public ownership or held in trust for the community," by Mr. Reiss, chairman, Executive Committee, Garden Cities and Town Planning Association.

The authors deal chiefly with utopian theories and desires, except for (1) the data about Letchworth and Welwyn, the only towns that the authors present as garden cities actually in existence; and (2) an earnest attempt by Mr. Unwin to discuss in a practical way the optimum size for a city.

Mr. Unwin's chapter and the value of the whole book as a brief, readable, up-to-date presentation of the garden city in theory, with some illustrations from practice, warrant recommending the volume to all who are interested in city planning. Some of the principles advocated are applicable to replanning work and to laying out additions to existing towns, while all are entitled to serious consideration in connection with planning new towns—particularly industrial communities.

Ethics of the Professions and of Business

Engineers seem to agree that if their calling is to be accorded the status of a full-fledged profession it must set up and enforce certain standards of practice generally understood under the term "code of ethics"; and several such codes have been adopted by professional societies. Many engineers however are not thoroughly clear as to the scope of a code of ethics and as to the spirit that breathes life into it.

Everyone interested in the subject will be glad, therefore, to know that the American Academy of Political and Social Science devotes most of the May, 1922, number of its *Annals* (Philadelphia; $1 a number) to a series of contributions on "The Ethics of the Professions and of Business." The discussions cover every profession and several departments of business. Some of them are very practical indeed and describe not only the development of the codes, but also the measures provided for their enforcement.

After an introductory section on the significance of ethical codes for the professions, there are considered, in detail, those of lawyers, doctors, engineers, architects, teachers, librarians, ministers, social workers, journalists and accountants. Commercial and business ethics are then discussed by representative business men who are looking ahead to the day when business may win for itself a professional standing.

The engineers who have contributed are Morris Llewellyn Cooke, consulting engineer; Calvin W. Rice, secretary, American Society of Mechanical Engineers; Frederick Haynes Newell, consulting engineer; Carl Hering, consulting engineer; H. W. Clausen, treasurer, American Association of Engineers; William J. Wilgus, consulting engineer, and A. G. Christie, professor of mechanical engineering at Johns Hopkins University.

PUBLICATIONS RECEIVED

New Books and Revised Editions

THE ALASKAN ENGINEERING COMMISSION: Its History, Activities and Organization—By Joshua Bernhardt—Institute for Government Research; Service Monographs of the United States Government No. 4. New York and London: D. Appleton & Co. Cloth; 6 x 9 in. $1.

A review of the history and activities of the organization that has been carrying on the location, construction and operation of the government railroads in Alaska, together with the collateral operation of coal mines, docks and power plants.

BELT CONVEYORS AND BELT ELEVATORS—By Frederic V. Hetzel, M.A.S.M.E., Member Franklin Institute of Pennsylvania. New York: John Wiley & Sons, Inc. Cloth; 6 x 9 in.; pp. 333; halftones and line cuts. London: Chapman & Hall, Ltd. $5 (25s. net).

THE BUILDING LABOR CALCULATOR—By Gordon M. Tamblyn. Denver, Colorado: G. M. Tamblyn. Flexible binding, containing 58 loose-leaf sheets. $5; monthly service $5 extra.

CEMENTS, LIMES AND PLASTERS: Their Materials, Manufacture and Properties—By Edwin C. Eckel, C.E., Affiliate Am. Soc. C.E.; Fellow, Geological Society of America. New York: John Wiley & Sons, Inc. Cloth; 6 x 9 in.; pp. 655; halftones, tables and line cuts. London: Chapman & Hall, Ltd. $6.50 net.

A COURSE IN ANALYTICAL GEOMETRY—By Paul P. Boyd, Head, Department of Mathematics, University of Kentucky. J. Morton Davis, Professor of Mathematics, University of Kentucky; Elijah L. Rees, Associate Professor of Mathematics, University of Kentucky. New York: D. Van Nostrand Co. Cloth; 5¼ x 8 in.; pp. 251; diagrams. $2.40 net.

EXERCISES IN THE ELEMENTS OF DESCRIPTIVE GEOMETRY—By Richard Shelton Kirby, C. E., Associate Professor of Engineering Drawing, Yale University. New York: John Wiley & Sons, Inc. Cloth; 7 x 10 in.; pp. 49; diagrams. London: Chapman & Hall, Ltd. $1 postpaid.

MANCHURIA: Land of Opportunities—Compiled and published by Thomas F. Logan, Inc. New York: South Manchuria Railway Co., 111 Broadway. Boards; 6 x 9 in.; pp. 113; halftones, diagrams and a map.

Contains chapter on railway mentioned above.

THE PETROLEUM AND ALLIED INDUSTRIES: Petroleum, Natural Gas, Natural Waxes, Asphalts and Allied Substances and Shale Oil—By James Kewley, M. A. (Cantab.), F.I.C., F.C.S. New York: D. Van Nostrand Co. Cloth; 5½ x 8½ in.; pp. 302; line cuts. $3.50 net.

A British book dealing with the origin, characteristics, uses, etc., of the materials indicated. American materials and literature are freely mentioned

A PRACTICAL TREATISE ON SUSPENSION BRIDGES: Their Design, Construction and Erection—By D. B. Steinman, A.M., C.E., Ph.D.; Consulting Engineer; M. Am. Soc. C.E., M.A.R.E.A; formerly Professor in charge of Civil and Mechanical Engineering at the College of the City of New York. With Appendix: Design Charts for Suspension Bridges. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Limited. Cloth; 6 x 9 in.; pp. 204; 62 line cuts and halftones. $4 net.

RAILROAD CONSTRUCTION: Theory and Practice—By Walter Loring Webb, M. Am. Soc. C.E., M.A.R.E.A., Assistant Professor of Civil Engineering (Railway Engineering) in the University of Pennsylvania, 1893-1901. New York: John Wiley & Sons, Inc. Flexible binding; 4¼ x 7 in.; pp. 845; including two hundred pages of logarithmic tables; halftones and line cuts. $5.

RAILROAD FREIGHT TRANSPORTATION—By L. F. Loree, President Delaware & Hudson Co., Chairman Kansas City Southern Railway Co. New York: D. Appleton & Co. Cloth; 5½ x 8½ in.; pp. 771; halftones and line cuts. $5.

Reports and Pamphlets in Various Fields

ADMINISTRATIVE CONSOLIDATION IN STATE GOVERNMENTS—By A. E. Buck, National Institute of Public Administration. New York Bureau of Municipal Research. New York City: National Municipal League. Paper; 7 x 10 in; pp. 40, line cuts.

Summarizes and comments on reorganization of the admistrative government of a number of states, both proposed and accomplished. A revision of an earlier pamphlet.

ANALYSES OF MINE AND CAR SAMPLES OF COAL: Collected in the Fiscal Years 1916 to 1919—By Arno C. Feldner, Walter A. Selvig and J. W. Paul. Washington: Bureau of Mines. Paper; 6 x 9 in.; pp. 391.

EXCAVATING MACHINERY USED IN LAND DRAINAGE—By D. L. Yarnell, Senior Drainage Engineer. Washington, D. C.: Bureau of Public Roads. Paper; 6 x 9 in.; pp. 49, illustrated.

Revision of a paper first issued in 1915. Describes types, compares kinds of power available, and has section on analysis of cost data.

IOWA ENGINEERING SOCIETY: Proceedings, 1922—Des Moines: Lloyd A. Canfield, Secretary. Paper; 6 x 9 in.; pp. 150. 50c.

IRRIGATION PRACTICE AND WATER REQUIREMENTS FOR CROPS IN ALBERTA—By W. H. Snelson, Senior Irrigation Specialist. Ottawa, Ont.: Canadian Reclamation Service. Paper; 7 x 10 in.; pp. 59; illustrated.

LE TUNNEL DU SIMPLON: Sa Construction, Son Achévement, 1898-1921. New York: F. Dossenbach, Official Information Bureau of Switzerland, 241 Fifth Ave. Paper; 6 x 9 in.; pp. 47; line cuts.

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH: Annual Report for the year ending November 30, 1920—Boston. Cloth; 5½ x 9 in.; pp. 393; line cuts.

PAVING BRICK STANDARDIZATION—Simplified Practice Recommendation No. 1: Paving Bricks. Washington, D. C.: Bureau of Standards. Paper; 6 x 9 in.; pp. 9. 5c. from Superintendent of Documents, Washington, D. C.

Summarizes Washington Conference of Nov. 15, 1921, called by the National Paving Brick Manufacturers Association under the auspices of the Department of Commerce. (2) Contains Department recommendation for reduction in number of sizes and varieties of paving brick in accordance with a second conference held March 27, 1922, the approval by Secretary Hoover being "subject to regular annual revision by similar conferences."

RESULTS OF SOME COMPRESSION TESTS OF STRUCTURAL STEEL ANGLES; Technologic Papers, Bureau of Standards, Washington, D. C., No. 218—By A. H. Stang, Associate Physicist and L. R. Strickenberg, Assistant Mechanical Engineer. Paper; 7 x 10 in.; pp. 11; halftones and line cuts. 10c. from Superintendent of Documents, Washington, D. C.

SANITATION OF BATH HOUSES—By William Paul Gerhard, C. E., Consulting Sanitary Expert. New York: William T. Comstock Co., 23 Warren St. Paper; 8 x 10 in.; pp. 16; halftones and line cuts. 60c.

STATE DEBTS: A Record and Analysis Compiled and Published by The Bank of North America, New York City—Paper; 11 x 9 in.; pp. 74; illustrated.

Gives gross outstanding debts by dates of issue and maturity, amounts, purpose and interest rate; contains summaries and diagrams.

TREND OF PUBLIC ACCIDENTS IN THE UNITED STATES: Report of the Committee on Public Accident Statistics, Public Safety Section, National Safety Council, for the year 1922—Chicago: National Safety Council, 168 North Michigan Ave. Paper; 6 x 9 in.; pp. 31; line cuts.

Analyses and comments on 1920 figures; also gives automobile and some other statistics for 1921, in comparison with similar figures for England.

UNION SCALE OF WAGES AND HOURS OF LABOR MAY 15, 1921: August Bulletin of the United States Bureau of Labor Statistics, No. 302—Washington, D. C. Paper; 6 x 9 in.; pp. 219.

Besides figures of the date named for various cities, gives comparative figures for the years 1907 to 1921.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Fire Hazard of Wood Shingles and Prepared Roofings

Sir—The discussion under way in your journal dealing with the controversy between the fire prevention interests and patent roofing manufacturers and the shingle industry has greatly interested us. Naturally we feel that those who are using every endeavor to prohibit the use of our product for any and every purpose are quite unjustified in their efforts, since we feel that, generally speaking, their claims are based on theory rather than on actual experience and practice in the use of roofing materials.

In the first place, the standards established by the National Board of Fire Underwriters through tests made at their laboratories (the Underwriters Laboratories, Chicago) are based on purely theoretical lines. The tests, grading the various types of roofing into classes A, B, and C, representing certain degrees of comparative fire-resistance, are made largely upon newly manufactured material, without giving consideration to the durability of these various materials. Evidently it is assumed that the various ingredients comprising the compounds used in the manufacture of prepared roofing material have the same value and durability in combination that they have separately. But experience has developed that this theory does not hold, because under the action of the elements much of the material listed under Classification C, of the Underwriters' tests, has developed after five or more years of exposure to the weather a very definite fire hazard on a roof.

ONE VIEW OF THE ATLANTA CONFLAGRATION

There are four different grades or qualities of prepared roofing today: roll roofing, four-in-one shingles, standard shingles, and jumbo shingles, each of these four being given a certain classification as to fire resistiveness. Then, too, there are culls, or what is known as B grade prepared roofing, which is not included in the four above named grades, which is not approved as being fire resistive in Class C of the Underwriters' rating. The Red Cedar Shingle is graded also in seven standard grades, as follows:

Star A Star	6 butts	measuring 2	in.,	16 in. long
Star A Star	5 butts	measuring 2	in.,	16 in. long
Extra Clears	5 butts	measuring 2	in.,	16 in. long
Perfects	5 butts	measuring 2	in.,	16 in. long
Eurekas	5 butts	measuring 2	in.,	18 in. long
Perfections	5 butts	measuring 2½	in.,	18 in. long
Royals	4 butts	measuring 2	in.,	24 in. long

These represent the seven grades of shingles manufactured today, none of which grades includes culls. Each of these grades has a different degree of fire resistance, largely dependent upon the nature of the grain.

The four grades Star A Star 6/2, Star A Star 5/2, Extra Clears 5/2, and Eurekas 5/2 contain what is commonly known as slash grain material, in different percentages. Slash grain shingles cannot be depended upon to remain flat, because with varying moisture there is a tendency to curl and so lift their corners from the body of the roof that they cause open spaces under the shingle, in which sparks at times may light and, fanned by a stiff breeze, ignite the shingle.

The grades called Perfects, Perfections and Royals contain edge grain material, because of which atmospheric changes in no way affect the flatness of the shingle on the roof and do not cause turning up of the corners with the possibility of holding sparks in spaces. These shingles have a degree of fire resistance required in semi-congested districts in large residential areas. The 18-in. shingles, being somewhat thicker at the thick end, have an increased fire resistance, and so in proportion do the 24-in. shingles, which are ½ in. thick at the thick end. This comparative fire resistance of the wooden shingle has never been taken into consideration by the fire prevention fraternity, who have maintained that *all* shingles, whether thick, thin, flat grain or edge grain, are "the greatest fire menace of the day."

It has been our experience, as well as the experience of many of the best-known and most reliable builders of the country, that a good grade of red cedar shingles carries with it a degree of fire resistance equal to if not more than that of other roofings theoretically given a classification in Class C, Underwriters' rating. The species of wood made into shingles are red cedar, redwood, yellow pine, cypress, white cedar, white pine, and oak. In quality the red cedar shingle represents approximately 85 per cent of the total. In years past the white cedar shingle was used largely in the North and Middle West, while the yellow pine shingle was used to a great extent on cheaper construction in the southern and eastern States. The action of these species of roofs varies materially, and while we do not wish to enter into any discussion of the comparative value of shingles made from these various species, the fact that red cedar shingles are the ones largely used at the present time would seem to indicate that their suitability and adaptability to roofs needs no argument.

The statement made by the Underwriters that "wood roofs are the chief sources of conflagrations" is very much exaggerated, as statistics of the great conflagrations of our age will bear out. We cannot agree that wooden shingles, more than any other Class C roofing, as dictated by the Underwriters, are responsible for what conflagrations may have been recorded as caused by wooden roofs, for most of our conflagrations in the past have covered the congested or business districts of our larger cities, and those which can be at all attributed to the wooden roofs have occurred in the southern states, where red cedar shingles do not predominate.

The fact that many of our older communities have roofs which have been in place for 35 years or more and are in excellent condition should not be overlooked as evidence of the durability of the wooden roof. The fact that shingle roofs predominate in residential districts throughout the

country should also be taken into consideration when we make the statement that there are fewer fires on roofs which are covered with material other than wooden shingles.

The guaranteed life of prepared roofing does not exceed 15 years and were the roofs in North America now covered with wooden shingles covered with prepared roofing, 15 year old or more, the fire hazard presented by these roofs would be something appalling. From this analysis, it is clear that the comparison made by fire preventionists and prepared roofing manufacturers with their own new roofings against an old shingle roof is not only unfair, but an unreasonable comparison. The Red Cedar Shingle Association has made many public tests at different points about the country which have proved that the fire hazard of a good shingle roof as compared to that of many of the products of prepared roofing manufacturers is far less. Many of these tests have shown that a fire brand has burned out on a new shingle roof where it has completely consumed, not only the roofing material, but the boarding underneath the same, of a prepared roofing product.

The Red Cedar Shingle Association feels, and is justified in so doing, that the fire underwriters are very much biased in their attitude toward our product and other products of wood, and are unreasonable in not classifying certain grades of our material in Class C roofing specifications, in which they classify certain grades of prepared roofing, which carries a very plainly evident fire hazard. If wooden shingles, as a class, carried the fire hazard that the fire underwriters claim, it is sufficient to prohibit their use entirely in certain communities, and it is quite illogical for them not to differentiate more between the rates charged for Class C roofing as against those charged for houses covered with wooden shingles, for these rates now vary from 5 to 10 cents in different localities.

Referring to the communication from the National Board of Fire Underwriters printed in your Aug. 3 issue, p. 201, which makes particular reference to the Atlanta conflagration: It is easy to prove anything by photographs. The view herewith shows a photograph taken just one block south of the house illustrated in your magazine, where the hazard was just as great. All roofs shown in this photo are covered with wooden shingles.

R. S. WHITING,
Sec'y, Shingle Branch,
West Coast Lumbermen's Association.
Seattle, Wash., Oct. 5.

Hydraulic Jump Formulas

Sir—In a letter in your issue of June 1, p. 923, Karl Kennison quotes a simplification of the Unwin formula, which he finds convenient and accurate enough in practice. He may be interested in my way of using the Unwin formula itself, which I find more convenient than his approximation.

Substituting h_1 for $V_1^2/2g$, the Unwin formula becomes

$$4h_1d_1 = d_2(d_1 + d_2)$$

To solve this:—mentally multiply by 4 either h_1 or d_1, whichever is more convenient; reverse the slide of a slide rule and bring this product against the other quantity, that is bring them together under the cursor; then if we move the cursor, any other pair of readings simultaneously under the cursor multiplied together will give the same product; and if we move the cursor till we find such a pair of readings whose difference $= d_1$, then the smaller of these two readings will $= d_2$.

Thus, if in an example $h_1 = 1.83$ and $d_1 = 0.75$, we have to set 3 against 1.83 we shall then find that 2 comes against 2.75, so that $d_2 = 2$.

Incidentally, the slide rule can be used in similar ways to solve any quadratic or cubic equation.

Another adaptation of the Unwin formula can be used to give the discharge; but the difficulty of measuring depths of water accurately makes it rough

$$Q^2 = g/2d_1d_2(d_1 + d_2)$$

The Unwin formula referred to by Mr. Kennison and adapted in two ways above applies to standing waves on smooth level floors.

As far as concerns roughness, such observations as I have been able to make seem to indicate that calculation by the formula allows for total loss in the wave, and that any increase of friction loss is balanced by a decrease of eddy loss in the stream.

But the said formula is a simplification of a fuller form containing a term, the drop of a sloping floor in the length necessary to complete the wave. No data that I have seen make it possible to deduce what length of floor should be taken into account. Can any reader of your paper help to fill this gap in our knowledge.

E. S. LINDLEY,
Research Section, Punjab Irrigation Secretariat.
Simla, India, July 29.

Industrial Sites and Transit Facilities

Sir—Referring to the letter of L. J. Carmalt in *Engineering News-Record* for August 24, 1922, p. 327, entitled "Economics of Selecting Industrial Sites," he truly states, "Freight transportation facilities are generally well studied out but those for passengers are rarely given any attention." There is a glaring example of this oversight right here in the city of Buffalo. Many members of the American Society of Civil Engineers will remember the Pan-American Exposition in 1901. After the closing of this exposition, instead of devoting the entire site to residential purposes, for which it was ideally suited, a large portion was built upon by industrial concerns, the largest being the Pierce Arrow Automobile Co. The vacant land north of the exposition grounds was covered by other manufacturing plants consisting of the Curtiss Aeroplane & Motor Corp., foundries, a large lumber-yard and smaller plants.

Situated farther north is the town of Kenmore, a residential suburb of Buffalo. The building of manufacturing plants in the very heart of a residential district can almost be classed as a calamity, when other sites just as good are available.

Again quoting Mr. Carmalt, "If the workmen have to spend an extra half hour, or pay an extra fare, etc." This is what many of the employees have to do who live on the east side of Buffalo. In many cases an hour each way is required to go to and return from work.

The building of these plants separates two desirable residence districts. It is necessary to cross the plant sites twice daily, creating an everlasting inconvenience.

Where there is a mixed residential and industrial traffic street cars cannot be kept so clean as would be desirable because of the need for so many workmen traveling in their working-clothes. To avoid this, a trial was made in Pittsburgh of separate cars for women, with double fare, but this plan did not prove practicable.

Buffalo, N. Y., Sept. 7. EMILE LOW.

Too Many Asphalt Grades

Sir—In an editorial in the Sept. 23 issue of *Engineering News-Record*, p. 502, you ask, "Are highway engineers insisting upon too great refinement in their specifications for road work?" Every highway engineer who has thoroughly studied the subject and is fair-minded will, I believe, answer that question affirmatively.

With the enormous paving program which confronts the United States it is high time that the subject of standardizing asphalt paving specifications be given full consideration, particularly as to the hardness requirement. By all means let us return to sanity by establishing a comparatively limited number of degrees of hardness. The national societies and associations whose function it is to standardize such specifications can do a great service to all concerned by so doing.

JAMES M. OWENS,
Highway Engineer, Board of Public Works.
San Francisco, Oct. 16.

NEWS OF THE WEEK

New York, November 16, 1922

Highway Research Board to Hold Second Annual Meeting

The Advisory Board on Highway Research of the National Research Council of which Dr. W. K. Hatt is director, will hold its second annual meeting at the headquarters of the National Research Council, 1701 Massachusetts Ave., Washington, D. C., Nov. 23 and 24. On the morning of the first day committee reports will be presented on economic theory of highway improvement, T. R. Agg; structural design of roads, A. T. Goldbeck; road materials, H. S. Mattimore; traffic analysis, G. E. Hamlin; highway finance, J. G. McKay; maintenance, W. H. Root; ways and means, C. J. Bennett.

The evening session will be devoted to technical papers and discussions and plans for the future.

For Nov. 24 visits of inspection to points where research work is in progress by the U. S. Bureau of Public Roads and the Bureau of Standards have been arranged.

Leader of Good Roads Advocates in Senate Is Defeated

Senator Charles E. Townsend, of Michigan, chairman of the Senate Committee on Post Offices and Post Roads, leader of the good roads advocates of the United States Senate, and author of federal-aid road legislation, was defeated for re-election in the general election held Nov. 7. His successor is a Democrat, the first the State of Michigan has had in seventy years.

The original Federal-Aid Road Act whereby a partnership between the federal government and the states in building roads on a basis of profit-sharing was established was enacted in 1916. This bill covered a five-year construction program. When the last of the allotments were made under the 1916 act additional legislation was sought. Against a great deal of opposition Senator Townsend succeeded in carrying through legislation for appropriations for 1921, 1922 and 1923, so that federal aid in the construction of highways could be continued.

Baltimore Adopts One-Branch City Council Plan

A one-branch city council of 19 members in place of the present two-branch council with a total of 39 members was adopted by the voters of Baltimore, Md., Nov. 7, by a vote of about 69,000 to 33,000. Three councilmen will be elected from each of the six districts, and a president will be elected at large. Salaries of councilmen will be increased from $1,000 to $1,500, making a total of $29,500 against $55,250 under the present plan, besides which one set of clerks will be eliminated.

General Election Favorable to Bond Issues Involving Construction Work

New Jersey $40,000,000 Road and Bridge Issue Wins—Election Results From a Number of States

Outstanding features in the election held Nov. 7 of interest to engineers and contractors were the general favorable vote given bond issues for public works improvements, the comparative scarcity of large issues, and the almost universal approval of bond issues involving construction of schools. Though few highway bond issues were voted upon, it is interesting to note that the largest among them—a $40,000,000 issue in the State of New Jersey for roads and bridges—barely received a favorable vote. The unofficial majority cast for the New Jersey bond issue was 14,000, which is considerably under the vote cast for successful candidates.

The New Jersey bond issue makes available $5,000,000 per year for the completion of the state highway system as laid out, and $3,000,000 per year for necessary bridges. Thus a five-year construction program is provided. Approximately 375 miles of the state highway system as laid out previous to the last session of the New Jersey Legislature are to be completed. A permanent type of surfacing will be laid. A sinking fund secured from a general levy of one mill will provide money with which to pay the interest on the bonds and finally retire them.

Colorado also voted favorably for bonding itself for the construction of highways, a $6,000,000 issue having been authorized. These bonds are to run for nineteen years and funds for interest and principal will come from motor vehicle license fees. Yearly appropriations of $1,500,000 will be made from this issue, providing a four-year construction program. As provisions have been made for road work in the 1923 budget, the $6,000,000 will not become available until the succeeding year.

Of chief interest among constitutional amendments is a proposed act (which was defeated) empowering the State of California to create a board which would authorize the issuance of bonds to develop and distribute water and electric energy, and, in general, exercise control over and administration of the state water-power resources. This legislation proposed the issuance of bonds not to exceed $500,000,000, the bonds to be retired from income upon rates accruing from developed resources.

Following is a summarized report upon bond issues and other legislation in the elections in various states:

Ohio—An act authorizing the installation of works to prevent the pollution of the Cuyahoga River was voted upon favorably. Money for the construction of such works is to be provided by an additional tax levy of not more than two-tenths of a mill.

Akron—$3,000,000 sewer bond issue passed.

Lima—$540,000 school bond issue passed.

Cleveland—$5,000,000 school bond issue passed.

Lakewood—$700,000 school bond issue passed.

Dayton—$500,000 issue for streets and sewers lost; $300,000 issue for parks and playgrounds lost; $650,000 issue for acquisition of hydraulic canal for public park lost.

Oakwood—$380,000 issue for high school carried.

Middletown—$210,000 issue for schools carried.

Michigan—Wayne County voted favorably on two bond issues; $1,000,000

(Continued on p. 859)

Steinmetz Runs Ahead of Ticket in State Engineer Race

According to unofficial returns, Charles P. Steinmetz, Socialist-Farmer Labor candidate for state engineer of New York, ran far ahead of his ticket in the election held Nov. 7. It is estimated that he received at least 200,000 votes not credited directly to the general Socialist or Farmer Labor vote. In the five boroughs of New York City he ran only about 75,000 votes behind the Republican candidate, though the Democratic candidate received about double the votes cast for the Republican candidate. In Schenectady, Mr. Steinmetz' home precinct, many Republicans and Democrats laid aside their political convictions and voted for him. In many of the up-state precincts the same thing happened.

A.S.T.M. 1923 Meeting Announced

The executive committee of the American Society for Testing Materials has voted to hold the 1923 annual meeting of the society at Atlantic City, N. J., in the latter half of June, provided satisfactory arrangements can be made for the meeting. Two dates of meeting are tentatively under consideration, the first during the last week of June, that is, from June 25 to 29, the second immediately following the meeting at Atlantic City of the American Railway Association which is customarily held from Thursday to Wednesday, about the middle of June. It is stated that the executive committee has the matter of rotation of annual meetings in different parts of the country under careful consideration, and in the meantime deems it desirable to adhere to the existing policy with respect to meetings.

Engineering Foundation to Study Arch Dams

Committee Has Collected Information on Existing Dams and has Program of Tests

Progress is being made in a study of arch dams by an advisory committee of Engineering Foundation which has recently been formed and which will hold its first formal meeting in San Francisco in December. The committee was organized at the solicitation of F. A. Noetzli, chief engineer, Bissell & Sinnicks, San Francisco, the author of several recent papers presented to the American Society of Civil Engineers on the subject of arch dams. Mr. Noetzli has been made a member and secretary of the committee, the other members of which are F. E. Weymouth, chief engineer, U. S. Reclamation Service, Denver, Colo.; A. B. Fletcher, director of public works, Sacramento (*alternate:* Paul Bailey, deputy chief of public works) representing the State of California; M. M. O'Shaughnessy, city engineer, San Francisco, (*alternate:* R. P. McIntosh, designing engineer) representing San Francisco; H. Robert Porter, member Engineering Foundation, New York City, (*alternate:* Wynn Meredith, of Sanderson & Porter, San Francisco); Silas H. Woodward, member of Engineering Foundation, New York City; Prof. C. Derleth, Jr., University of California, Berkeley, Calif.; H. Hawgood, consulting engineer, Los Angeles, Calif., and D. C. Henny, consulting engineer, Portland, Ore. All members of the committee are members of the Am. Soc. C. E.

Purpose of Investigation

The purpose of the investigation is first to collect all possible information regarding design, dimensions, history and behavior of existing arch dams and second to study by observation on existing dams, or those to be built in the near future or on test dams, the movements under changes of load and temperature, from all of which it is hoped that there may be evolved some more rational and generally acceptable method for the design of arch dams than those now in use. Among the ends sought are economy combined with the degree of security demanded in each case and some assurance as to safety.

Engineering Foundation has appropriated $500 to meet the preliminary expenses of the committee and will act as treasurer for such contributions as are made to the investigation. Several firms engaged in the design and construction of arch dams, and others, mainly power companies owning or contemplating such dams, have already offered assistance in making observations and have indicated willingness to contribute to the fund at the required time. One engineer interested in the study has incorporated in some new contracts a provision that a sum equal to one-half of one per cent of the estimated cost of the dam is to be donated by the owner to the investigation.

Further information regarding the investigation may be obtained by writing to Alfred D. Flinn, director, engineering Foundation, 29 W. 39th St., New York City. The official name of the committee is the Advisory Committee on Investigation of Arch Dams.

To Test Practicability of Joint Committee Specifications

The Joint Committee on Standard Specifications for Concrete and Reinforced Concrete, has accepted a proposal of a committee of contractors representing the Associated General Contractors of America that field and laboratory tests be conducted to determine the practicability of the recommendations of the Joint Committee in its Tentative Specifications for Concrete and Reinforced Concrete especially insofar as they relate to control of the quality of concrete produced under field conditions. It is at present planned to conduct the tests in conjunction with the construction of a reinforced-concrete building in the New York City district, with the possibility eventually of making similar tests on buildings in other cities. The Joint Committee, without expense to itself, will have advisory supervision of the tests under the auspices of a committee of contractors; it will approve the program of tests and the personnel of those who are to supervise and make the tests.

Although final plans have not yet been approved, it is contemplated to divide the tests broadly into field tests and auxiliary and laboratory tests. The field tests will be designed to establish (1) uniformity of workability or consistency of concrete throughout the work, (2) uniformity of the strength of concrete obtained throughout the work, and (3) relation of the strength of field test pieces to the strength of concrete in the structure. The auxiliary and laboratory tests are divided into four series: (1) the relation of strength of field-made test pieces to theoretical strength of mixtures used; (2) comparison of strength of field-made test pieces with laboratory test pieces; (3) relative value of cores of different diameters and heights, and (4) comparative tests of different brands of cement used.

Policy Being Evolved to Govern Inter-Bureau Patent Matters

With the idea of drafting regulations establishing a policy to be followed by the federal government in handling inventions and patents evolved by government employees, and other inventions and patents acquired by the government, regular meetings are being held by the Interdepartmental Patents Board. This board recently was set up by an executive order issued by the President. Any policy proposed by this board is to be presented, through the Secretary of the Interior, to the President for his approval. The regulations also will suggest a plan whereby information concerning patents, applications for patents, licenses and other rights under patents, owned by the government, may be disseminated to all the bureaus concerned.

Dr. Andrew Stewart, of the Bureau of Mines, is chairman of the Interdepartmental Board.

Am. Soc. C. E. Has 10,509 Members

The total membership of the American Society of Civil Engineers as of Oct. 3, 1922, is 10,509. There are 4,622 members and 5,235 associate members, making 9,857 corporate members; 11 honorary members, 461 juniors, 170 affiliates, and 10 fellows.

Iowa Water-Works Men Talk on Operating Problems

Three-Day Convention Devoted to Lost Time Elimination, Publicity and Laboratory Control

How to minimize lost time in construction by load-curve studies, proper publicity for a water-works, and laboratory control problems were topics eliciting lively discussions Nov. 1-3 at the meeting of the Iowa Section of the American Water Works Association—which includes Iowa, Missouri, Nebraska and South Dakota. The plan to hold the first day's sessions in Iowa City and then proceed to Cedar Rapids for the remainder of the convention worked well and materially increased the total registration which was more than 100. Two manufacturers had exhibits and seven associate members were present. Some criticism of the number of laboratory papers was voiced but the onus was put back on the shoulders of the superintendents whose contributions are as difficult to secure for the local sections as for the parent organization.

Homer V. Knouse, assistant superintendent and purchasing agent, Omaha Metropolitan Utilities District, showed load curves of excavators by which the operators were induced to speed up and reduce between-job periods to a minimum. Organization and planning were found larger factors than were anticipated. For filling in the lost-time valleys of a backfiller other work, such as unloading pipe and hoisting concrete to column forms, was done.

Publicity

On publicity, Dow R. Gwinn, president Terre Haute (Ind.) Water Co., indicated that the utility manager should more often approach the advertising department and buy space for his non-news propaganda rather than attempt to palm it off on the editor. R. E. McDonnell, consulting engineer, Kansas City, described the methods used by the Engineers Club to educate the people on the recent $11,000,000 bond issue voted upon favorably.

In one of the laboratory papers, Frank Raab, chemist and bacteriologist of the Minneapolis filtration plant, stated that more than 90 per cent of the gas formers found in 932 samples in the filtered water were harmless spore formers other than B coli, requiring for their destruction 15 lb. of chlorine. A. P. Larned, with Black & Veatch, consulting engineers, Kansas City, noted a similar experience four years ago at Camp Beauregard.

F. C. Mortensen and C. O. Bates, Coe College, described experimental and laboratory studies of hydrogen-ion determination in connection with the use of a new temporary wooden tank.

J. B. Thornell, chemist Council Bluffs (Iowa) water-works, described the process proposed for softening Missouri River water and the preliminary laboratory experiments. Lewis I. Birdsall, General Chemical Co., in discussion, warned against an attempt to produce floc with magnesium precipitate because of the secondary reactions which are almost sure to follow.

The new officers of the section are: Dr. Edward Bartow, chairman; H. F. Blomquist, vice-chairman; and J. J. Hinman, Iowa City, secretary-treasurer.

Italy's New Ambassador to U. S. Is Columbia Engineer Graduate

Prince Gelasio Caetani, a member of the Chamber of Deputies of Italy, graduate of the Columbia University School of Mines, New York City, and former consulting mining engineer of San Francisco, has been appointed Italian ambassador to the United States. Since the war Prince Caetani has been prominent in Italian civil affairs, having been selected mayor of Rome prior to his election to the Chamber of Deputies on the Nationalist ticket. Before the war and after his graduation from Columbia he followed mining operations in the West and in Alaska, finally becoming a partner in a consulting mining engineering firm located in San Francisco.

Prince Caetani, the son of the Duke of Sermoneta, entered the Columbia School of Mines in 1899, and was graduated in 1903. He began work as a miner, trammer, timberman and mill hand at Strattons Independent Mine in Colorado, at the Treadwell in Alaska and at the Bunker Hill Mine in Idaho. In 1910 he became a partner in the consulting mining engineering firm of Burch, Caetani & Hershey, San Francisco. In his consulting capacity he designed the newest of the big mills of the Bunker Hill and Sullivan Co. in the West and won recognition as a metallurgist.

At the outbreak of the war he returned to his native country and was commissioned a captain of engineers in the Italian Army. He was assigned to duty with the 1st Royal Engineers under Col. Pettino Garibaldi, and was stationed in the Dolomite region. During his service there he executed one of the remarkable engineering feats accredited to Italians during the war—the undermining and blowing up of the Col di Lana, where an Austrian force had established a strong position dominating the surrounding territory. This work was carried out at an elevation of 2,464 meters above sea level and constituted in the main the driving of a tunnel over 300 ft. long, its loading with 5 tons of gelatine and 92 per cent nitroglycerine, and its explosion. The driving of the tunnel began in January, 1916, and was carried on under constant dangers from countermining operations. The excavation was completed April 17 and the mine exploded on that day, making a crater 90 by 150 ft., oval in shape, and about 35 ft. deep, and resulting in the death or capture of the entire Austrian garrison.

For his war exploits Prince Caetani was made a colonel of engineers and decorated with both the Italian and the British military crosses.

Waste in Industry to Be Theme of Industrial Conference

Elimination of waste in industry will be the theme for discussion Nov. 22 at the sixth annual New York State Industrial Conference to be held at the Hotel Lafayette, Buffalo, for three days beginning Nov. 21. At that particular session L. W. Wallace, executive secretary of the Federated American Engineering Societies, who has but recently completed a coast-to-coast tour, will deliver the opening address. His topic will be "Wasteful Industrial Habits." H. F. Simmons of the General Electric Co., Schenectady, N. Y., will speak on "How to Prevent Waste of Materials."

F. W. Sarr Dies From Injuries in Automobile Accident

Frederick Winton Sarr, first deputy commissioner of the New York State Highway Commission, died last week at Poughkeepsie, N. Y., following an automobile accident in which the machine, trying to avoid collision with another, crashed into a tree and overturned, Mr. Sarr receiving a compound fracture of the leg and internal injuries. Amputation of the leg was necessary and Mr. Sarr failed to survive the shock.

Mr. Sarr was born in Marcellus Falls, N. Y., in 1867. His early field work was with the Syracuse & Salmon River Water Co. and the Northern Pacific R.R. In 1891 he was chief engineer of the Hoosac Tunnel & Wilmington R.R. in charge of 13 miles of construction; the next year he had charge of 8 miles of construction on the Missouri, Kansas and Texas R.R. The following years were spent in New York in the State Department of Engineering and Surveying, varied by considerable outside work such as engineer in charge of construction of a 700-ft. dam for a pulp and saw mill near Wilmington, Vt.; assistant engineer on reconstruction of five locks of New York State canals, spillways, waste-weirs, aqueducts and culverts; on dams and spillways for reservoirs in the North woods; surveying, mapping and construction of New York State highways; engineer in charge of construction of the Post water-works at Fort Dade, Fla.; and in the chief quartermaster's office, Department of the East, Governor's Island, New York.

In 1915 Mr. Sarr became second deputy commissioner of the New York State Highway Commission, serving until 1918. From that year until 1921 he was with the Asphalt Association and the Portland Cement Association, as field engineer.

In 1921 when a change of state administration resulted in the appointment of the present commissioner of highways, Mr. Sarr returned to the department as first deputy commissioner.

Highway Traffic Association to Meet in Grand Rapids

The joint sessions of the North Central Division of the National Highway Traffic Association and the Michigan State Good Roads Association are to be held at Grand Rapids, Mich., Nov. 21. Papers covering the discussion of regulations on speeds, weights, dimensions of motor trucks, their overloading, and discussions on lights for highway vehicles, both motor driven and horse driven, will occupy the afternoon session. The evening session will be devoted to papers upon the economic and financial aspects of highway construction, maintenance and transportation.

Rivers and Harbors Congress in December

Announcement has been made that the eighteenth convention of the National Rivers and Harbors Congress will be held in Washington, D. C., Dec. 6 and 7, at the New Willard Hotel, that city.

Call for Engineers Generally Continues Strong

Although a lull in engineering employment usually comes with the approach of winter, indications this year favor a continuation of the present upward trend of engineering employment, according to the employment department of the American Association of Engineers. Developments in all engineering lines warrant the belief that this trend has just started and that probably it will continue well into 1923. Practically no engineers are unemployed. Those who are without positions are in remote localities; highly specialized men whose positions may have been just completed, and a few construction men.

The demand for office men, particularly in connection with building construction, is rather acute. Structural designers can command as high as $350 a month. A healthy demand exists for construction engineers and superintendents. The men who are available for employment are those endeavoring to better their situations. Possibly the least active lines are the chemical, mining, metallurgical and mechanical as it pertains to manufacturing. The following table shows the trend of employment:

	Sept. 1922	Aug. 1922	Sept. 1921
Applicants for employment	1,223	1,416	1,749
Positions received	437	467	348
Men referred	1,165	1,140	1,861
Men placed	167	219	213

From a wide variety of sources covering the entire country, the averages of engineering salaries per month at present are as follows: Tracers, $125 to $150; detailers, structural, mechanical and electrical, $150 to $210 (a few companies pay up to $225 a month for experienced men); designers on all classes of work, $225 to $300; structural designers who are specialists, as high as $350; estimators, $300 to $350; rodmen and levelmen, $125 to $160; instrumentmen, $150 to $160; chiefs of parties, $160 to $225; assistant engineers, $200 or more; map draftsmen, $150 to $200; surveyors, $150 to $190; research engineers, $175 to $250; salaries for building superintendents and mechanical engineers vary with duties and company. Pay for temporary positions averages 20 per cent more than the above figures.

Military Engineers Nominate

The nominating committee of the Society of American Military Engineers has placed before the national body its list of nominations. The committee calls attention to the fact that additional nominations may be made if a nominating letter signed by ten members reaches the secretary of the society by Dec. 1. The following nominations have been made: President, Major-Gen. William C. Langfitt, Flushing, N. Y., and Brig.-Gen. William B. Parsons, New York City; first vice-president, Col F. C. Boggs, and Col. William Kelly, Washington, D. C.; second vice-president, Lieut.-Col. Henry C. Jewett, and Col. John Stewart, Washington, D. C. Nominations have also been made for two directors from the regular army, two from the reserve corps and national guard and two directors-at-large.

Election Favors Bond Issues

(*Concluded from p. 856*)

issue for the erection of an institute for the feeble minded and another of $900,000 for additions to the infirmary.

Voters in the state also authorized an amendment to the state constitution providing for comprehensive port development. By this amendment the state legislature may authorize the incorporation of ports and port districts with power to make internal improvements. This bill, it is believed, will greatly facilitate the establishment of deep waterway terminals in Detroit which are needed for commerce of the Great Lakes and would, it is believed, be greatly overtaxed should the St. Lawrence waterways project open up the Great Lakes to transatlantic trade.

Detroit—A bill proposing a bond issue of $5,000,000 for the extension of the municipal street railways and for the acquisition of new equipment was defeated. Another bill defeated was the proposal that paving costs between car tracks be borne exclusively by a general tax levy instead of by proportionate levies on the city and public service.

Virginia — Arlington County voted favorably upon an issue of $365,000 for school buildings.

Louisiana—The city of New Orleans has been granted authority to issue $5,000,000 of Public Belt R.R. bonds, proceeds from the bonds to be used for the development, extension, additions and betterments to the Public Belt R.R. A bill proposing the issuance of $2,000,000 in bonds for the construction of an auditorium in New Orleans was defeated. Another bill given a favorable majority allows the Orleans Levee Board authority to build a seawall from West End to Seabrook, to construct a driveway along the shore of Lake Pontchartrain, and to reclaim 48,000,000 sq.ft. of land along the lake.

Minnesota—Practically the only large issue in Minnesota was one of $5,000,000 for school construction work in St. Paul which was voted upon favorably.

California—Water and Power Act defeated.

An act providing for a bond issue of $10,000,000 to be used by the Veterans' Welfare Board in assisting California war veterans to acquire farms or homes was voted upon favorably.

An act known as the State Housing Act, which sought to regulate the construction, alteration, maintenance, use, and occupancy of tenement houses and hotels throughout California and of dwellings in incorporated municipalities was defeated. The act defined fireproof, semi-fireproof, and wooden buildings and required roofs of all semi-fireproof buildings and wooden buildings in incorporated municipalities to be constructed of approved incombustible materials.

An effort to impose a taxation upon publicly owned public utilities failed, as did also a bill proposing the regulation of publicly owned public utilities placing them upon the same footing as privately owned utilities.

Maryland—The city of Baltimore, besides voting favorably upon a bond issue which will provide $15,000,000 for school construction purposes, also voted to establish "the one-branch city council plan," details concerning which are to be found elsewhere in these pages.

The Engineer in Public Life

W. W. FINEREN

Participation in the religious affairs of the State of Florida is the outstanding feature of the non-technical service record of W. W. Fineren, U. S. assistant engineer at Jacksonville. For three successive years he has been elected state chairman for Florida of the Laymen's Missionary Movement of the Baptist Church, which carries with it representation on the board of the Southern Baptist Convention. In this work he has addressed thousands of laymen in conventions and churches throughout Florida. He has also spoken before students at the University of Florida and Stetson University on the ideals and opportunities of the professional engineer. Mr. Fineren is a member of the Business Men's Evangelical Club of Jacksonville, an organization of fifty business men who visit all parts of the county every Sunday holding religious services in communities where there are no leaders or teachers. All of this work is done without compensation and at the members' own expense.

Mr. Fineren was born Sept. 11, 1879, at Oswego, N. Y., won a competitive scholarship at Cornell University, and was graduated from that institution in 1902, having specialized in civil engineering. After leaving Cornell he entered the service of the government at Oswego and was attached to the U. S. Engineer Office, his duties relating to dredging and breakwater construction in the lake region. Since that time he has been transferred from place to place in connection with the river and harbor work of the engineer department of the army. In 1917 he was sent from Tampa to Sandy Hook on the construction of defenses for New York Harbor and since 1918 he has served as assistant engineer in charge of coast defenses at Key West, Tampa, and St. Augustine. He holds membership in the American Society of Civil Engineers, Society of American Military Engineers, is a vice-president of the Florida Engineering Society and past-president of the Jacksonville Chapter of the American Association of Engineers.

Ohio Water Purification Plant Operators To Meet

A conference of superintendents of water purification plants in Ohio has been called to meet Nov. 16 and 17, at the Southern Hotel, Columbus, Ohio, by the chairman of the conference, J. W. Ellms, of Cleveland. One of the two sessions of the conference will be devoted to answering questions relating to filtration plants that were raised by the Ohio State Department of Health at the conference held last year. There are 58 water purification plants in Ohio.

To Discuss Steel Stresses

Simplification and co-ordination of allowable stresses in steel is to be discussed at the convention of the National Steel Fabrication Association, which will be held in Pittsburgh Nov. 23. It is believed that arrangements will be made at that time whereby the association will co-operate with the Department of Commerce to carry through a program of simplification along the lines of the program recently adopted by the lumber manufacturers.

The Department of Commerce is meeting with encouraging success in its simplification work in co-operation with automobile equipment manufacturers. Paint and varnish manufacturers are considering the continuation of some of the war-time restrictions on sizes of containers. Salt producers also are joining in a movement to simplify the containers in which their product is handled.

New Bridge Spanning Mississippi to Be Built in St. Paul

St. Paul is to have a new concrete bridge over the Mississippi River. The structure will replace the present steel bridge at Robert St., will be about 1,500 ft. long and will cost about $1,250,000. The width of the new bridge has not been determined. Toltz, King & Day, St. Paul, have been engaged as engineers to draw plans. It is expected preliminary plans will be ready by Jan. 1, 1923. The construction will be under direction of the Board of County Commissioners of Ramsey County. The county already has authority to issue $900,000 in bonds for the project, and an additional authorization will be asked of the Minnesota Legislature this winter.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The North Carolina Section of the American Water Works Association held its annual meeting in Gastonia, Nov. 14-16. Besides the sessions on water-works problems of general interest, there were special sessions devoted to well-works operators and for filtration plant operators.

The Western Society of Engineers' November program includes a paper, Nov. 27, by J. L. McConnell, consulting engineer. Chicago on "Industrial

Plant Design." At a noonday luncheon Nov. 24 C. H. Markham, president, Illinois Central R.R., will be the speaker.

The Four-State Section of the American Water Works Association will be the guests of the Water Department of Baltimore Nov. 18. Automobiles will leave the Baltimore City Hall at 12:30 p.m. for the Montebello filtration plant where luncheon will be served at one o'clock. After lunch a short address will be made by William A. Megraw, water engineer of Baltimore. This will be followed by two papers: "A Discussion of the Finances and Conduct of Business of a Municipally-Owned Water-Works as Segregated from Other Municipal Operations" by V. Bernard Siems of the engineering and construction division of the Baltimore Water Department; and "Recent Developments in Water Purification at the Montebello Filtration Plant" by James W. Armstrong, filtration engineer of the Baltimore Water Department. Those attending the meeting must be provided with tickets which may be obtained from Mr. Siems, local chairman, or from C. R. Wood, secretary, 400 Chestnut St., Philadelphia.

PERSONAL NOTES

W. P. CREAGER has resigned his position as engineer of hydraulic structures with the J. G. White Engineering Corp., to accept the vice-presidency of the Northern New York Utilities, Inc., Watertown, N. Y.

E. J. MEHREN, editor of *Engineering News-Record*, addressed the freshmen engineering students at New York University Nov. 13 on "The Importance of English to Engineers."

COL. WILLIAM V. JUDSON and COL. JAMES G. WARREN, Corps of Engineers, U.S.A., have been retired. Col. Judson has been division engineer of the Northwestern Division and stationed in Chicago, and in charge of improvement of the harbors at Chicago and Calumet, Ill., Indiana Harbor and Michigan City harbors, Ind., the Chicago River, Ill., and Calumet River, Ill., and the Illinois River, Ill. COL. WARREN is division engineer of the Lakes Division in charge of operations of power companies at Niagara Falls. He is best known for research and investigatory work in connection with Niagara Falls power development, results of which were published several years ago.

NATHAN WOHLFELD has been made construction superintendent for the Central Contracting Co., Shreveport, La. He was former manager of the Donaghey Co., Little Rock, Ark.

COL. GEORGE M. HOFFMAN, on duty in the office of the Chief of Engineers and resident member of the board of engineers for rivers and harbors, has been detailed as a consultant or a supervisor of construction or repair of any aid to navigation authorized by Congress in the seventh and eighth lighthouse districts. He succeeds COL. HENRY C. NEWCOMER.

H. COLLINS WIGHT, since 1915 superintendent of the Dayton, Ohio, water-works, announces that he has accepted an executive position with the Linden Chemical Co., Dayton. The Dayton officials credit him with many improvements in the city's water-works system.

OTTO WITTEN, civil engineer of Van Wert, Ohio, has been elected to the office of county surveyor in Van Wert County.

A. J. GOODE, county engineer of Fannin County, Texas, has resigned on account of ill health.

F. A. BISBEE, chief engineer of the western lines of the Santa Fé system for the past ten years, has resigned. Mr. Bisbee plans to spend some time at his home near Los Angeles where he owns a large olive orchard. His total service with the Santa Fé was forty-five years. He will be succeeded by M. C. BLANCHARD, superintendent of the Illinois division and stationed at Chillicothe, Ill.

GUY R. JOHNSTON, until recently principal assistant engineer for the Tarrant County Highway Department, Ft. Worth, Texas, has resigned to become engineer for the Hamer Contracting Co. of Ft. Worth.

DR. ROBERT T. HILL has been retained by the City of Dallas, Texas, as city geologist and will co-operate with the city engineering department on water supply investigation.

LOUIS W. B. MANTEL, Uvalde, Texas, was recently appointed city engineer of San Angelo, Texas, vice LOUIS LAGING, resigned. Mr. Mantel was an engineer officer in the army with the rank of major and saw service in France.

N. S. MULLICAN, civil engineer of Walnut Cove, N. C., and county engineer for Stokes and Davie counties, has been employed to prepare plans and supervise the installation of certain sewer works for the town of Cooleemee, N. C. He has also been retained by the town of Walnut Cove, N. C., to supervise certain hydro-electric developments on the Dan River.

VICTOR T. GOGGIN and JAMES H. RIPLEY, formerly contracting engineers with Dwight P. Robinson & Co., Inc., New York City, have formed a partnership under the name of Goggin and Ripley, Inc., with headquarters at 350 Madison Avenue, New York City. Personal service to assist business executives, bankers and engineers in conceiving, financing and developing construction projects will be specialized in.

H. C. WEBSTER, former estimating engineer with H. Schmitt & Son, Inc., general contractors of Milwaukee, Wis., has become a junior member of the general contracting firm of Hartung & Webster, Chicago, Ill. Mr. Webster will assume charge of the office and executive duties of the firm.

G. S. HINCKLEY, city engineer of Redlands, Calif., has been appointed to take charge of the flood-control work to be carried on in the headwaters of the Santa Ana River by San Bernardino, Riverside, and Orange Counties.

THE GEORGE H. COLLINS CONSTRUCTION CO. has been incorporated in Kansas City to do a general construction business. The shareholders are George H. Collins, R. V. Aycock, and Robert T. Stokes.

HENRY A. KELLER, formerly employed by the North Carolina State Highway Department as resident engineer and assistant resident engineer on highway location and construction, respectively, has been appointed district highway engineer of the Samuel Miller District of Albemarle County, Va.

OBITUARY

EDWARD H. TAYLOR, second vice-president of the Pennsylvania Lines West until his retirement two years ago, died recently at his home in Sewickley, Pa., aged 72 years. Mr. Taylor entered the service of the Pennsylvania R.R. in 1870.

ANDREW J. ROBINSON, head of the New York building-contracting firm of that name, died Nov. 9 at his home in New York City, aged 78 years. He was the builder of many of New York's important buildings, including the St. Luke's and New York hospitals, the Fidelity & Casualty Co. building, the Home Title Insurance Co. building in Brooklyn, the Columbia School of Mines, and the Union Geological seminary.

WILLIAM A. STROTHER, vice-president of the Franklin Contracting Co. of Newark, N. J., died Nov. 7 at his home in Montclair, N. J., aged 45 years.

J. PORTER PALMER, civil engineer of New York City, died recently at Homestead Hall, Greenwich, Conn., aged 55 years. He was born in Salem, Mass., and was graduated from the Massachusetts Institute of Technology. He was engaged in the oil business in New Haven prior to his establishing civil engineering offices in New York City.

ARTHUR JONES ROCKWOOD, a civil engineer and contractor of Rochester, N. Y., died recently in that city, aged 57 years. Mr. Rockwood was born in Enfield, Mass., and educated in the Buffalo public schools and at Rensselaer Polytechnic Institute, from which he was graduated in 1887. Until 1899 he was employed in Buffalo, when he went to Rochester to become engineer of the Western Division of the New York State Barge Canal. He held that position for nine years, leaving public service to enter the contracting field in highway construction work. He was a charter member and an early president of the New York State Road Builders' Association and was also a member of the American Society of Civil Engineers.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

To Simplify Practices and Products of Industry

U. S. Department of Commerce Reports Progress on its Program in Many Fields

Washington Correspondence

While the Simplification Division of the U. S. Department of Commerce is concentrating on lumber, hardware and containers as immediate objectives in its simplification program it is co-operating with trade organizations representing more restricted fields and is making plans for new efforts in 1923.

Attachés of the division are hopeful that strides toward standardization and simplification of ship construction and equipment, with especial reference to fittings, will follow the meeting on Nov. 10 in New York of representatives of 27 marine organizations and of the Department of Commerce.

Paint and Oil

On Nov. 14, Wm. A. Durgin, chief of the Simplification Division, is scheduled to address the National Paint, Oil and Varnish Association at its convention in Atlantic City to further the work of standardization which has been started by that organization. The association has under way a survey of colors and of containers which is expected to lead to more economical practices. Mr. Durgin will go from Atlantic City to Chicago where on Nov. 16 he is scheduled to address the convention of the Automotive Equipment Association on the same topic. This organization has made considerable progress in a survey covering batteries, spark-plugs, ball-bearings and tires.

Representatives of producers, manufacturers and consumers will meet with officials of the Department of Commerce in Washington, Dec. 12, to perfect plans for simplification of metal lathes. The preliminary survey has been completed and one meeting already has been held.

Hardware Expert Appointed

The Simplification Division recently has added to its personnel an expert on hardware who will devote special attention to carrying forward the work which has been opened in that field. A conference will be held in Chicago at an early date with Herbert P. Sheets, secretary of the National Hardware Association, who has been conducting a survey, with special reference to hammers, axes, hatchets, files, scissors and pocket-knives, which has disclosed an astounding diversity of sizes and types.

One of the largest subjects taken up by the division is that of containers—metal, wood and pasteboard. This affects such a large number of producers and consumers that the division has assigned a special attaché to this subject. A general conference on containers will be held in Washington under the auspices of the Department of Commerce in January, and probably will occupy a week's time.

Winter Buying of Pipe

Discussion continued from last week's issue.

F. A. McInnes
Division Engineer, Water Division, Public Works Department, Boston

I cannot refrain from expressing my appreciation of the idea that water-pipe manufacture should be spread over the entire year rather than be concentrated in a part only of the year. Such an arrangement should result in lower prices and would unquestionably make for a better product, as the manufacturers would have the great advantage of being able to offer continuous employment to their men and would avoid the unhealthy pressure that now obtains during a part of the year.

One reason for the present uneven demand for pipe is the fact that the majority of cities and towns defer action until their yearly budget or appropriation is made available. Consequently, congestion in the foundries is the inevitable result in the spring and summer months, a condition that cannot make for the best results.

Boston, for the first time as far as I know, is advertising now for the pipe for 1923 work with the expectation of getting better results both from a financial and mechanical standpoint than if we came into the market as has been our practice in the spring of 1923.

F. C. Jordan
Secretary, Indianapolis (Ind.) Water Co.

There is no question but what it would be desirable, from the manufacturer's viewpoint, to spread the purchase of pipe over the entire twelve months rather than concentrate these purchases in the summer months. Weather conditions, however, must be considered, and these conditions largely regulate the purchase and delivery of our material.

Our 1922 purchases were made early in the season, and when our pipe laying

(Continued on p. 862)

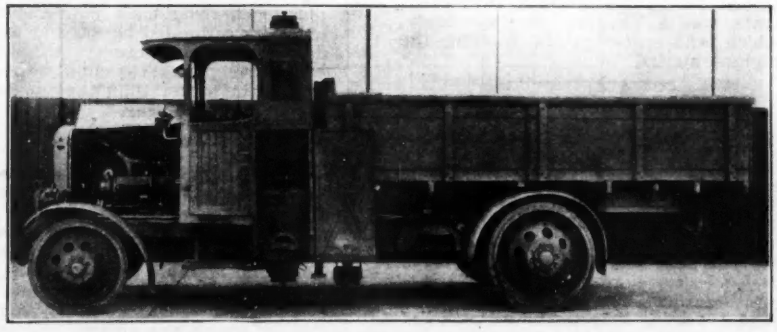
Producer Gas Used as Fuel in British Trucks

Tests Indicate Economies in New Development as Compared with Use of Petrol

London Correspondence

SEVERAL types of motor truck in which producer gas is used as fuel are on the English market. The Thornycroft plant, shown in the accompanying illustration, differs from others in several essential features. Steam, which is passed through the incandescent coal bed, on the grate, to form the gas by combining with the carbon, is generated in a separate generator (not attached to the producer) by the heat of the exhaust gases from the engine itself. The heat of the exhaust gases necessarily is in proportion to the power developed by the engine according to its load; thus the correct amount of steam for the producer can be provided under all conditions. The steam generator can be taken entirely to pieces for cleaning by detaching it from the engine.

One of the difficulties encountered in the running of gas-producer vehicles is the immediate provision of a sufficient quantity of proper quality gas on opening up an engine after the vehicle has been standing for a time, say, in a traffic block in the city. With the Thornycroft plant, special patented arrangements overcome this difficulty, which also occurs in a lesser degree when the vehicle is working on a very light load, or when over-running when going down hill. This arrangement overcomes the necessity of racing the engine when working at other than full power in order that the gas-making process may be continuous.



BRITISH TRUCK EQUIPPED WITH PRODUCER GAS PLANT
Engine is standard petrol machine, 4-cylinder. Compression ratio raised for running on producer gas. Fuel may be anthracite, coke, wood or charcoal

The plant works efficiently with good clean anthracite of the size known as pea, good quality coke and charcoal; but in the case of light and bulky fuels, such as the latter, special hopper arrangements are necessary to enable relatively larger quantities to be carried.

From the report attached it will be seen that the consumption of anthracite per mile is 2.51 lb. on the works vehicle taken over a distance of 1,579 miles in ordinary town-and-country commercial work the consumption worked out at 2.6 lb. per mile on a vehicle, the average speed over this distance being 14.8 miles per hour. The truck does about 7 miles per gallon of petrol.

per gallon of petrol say at 2s. a gallon, and 2¼ lb. of anthracite per mile at 63s. per ton, the fuel cost per mile is: Petrol, 3.43 pence per mile; anthracite 0.75 pence per mile. The cost of fuel on a gas-producer vehicle, therefore, is about one-fifth that of a petrol vehicle, on the basis of the foregoing costs. In countries where petrol is scarcer and alternative fuels cheaper still, the economy of the gas-producer plant is even more pronounced.

ROAD TESTS OF ANTHRACITE AND CHARCOAL ON THORNYCROFT GAS PRODUCERS

	Anthracite	Charcoal
Distance	28 miles	28 miles
Time	2 hr. 20 min.	2 hr. 5 min.
Miles per hour	12	13.4
Lbs. per mile	2.51	2.9
Water used, lb.	45	35
Gross weight	7 tons 10 cwts. 2 qr.	7 tons 9 cwts. 2 qr.
Pulling	Fair	Good
Condition of roads	Dry	Dry
Weather	Fine	Fine
Date of test	6-4-22	26-4-22

The Automobile Club de France has recently conducted a lengthy series of trials of suction gas vehicles, on behalf of the French Government, which is much impressed by their possibilities for colonial service. Among a number of colonial lorries the only British extrant was a Thornycroft 4-ton lorry, which was successful in winning the highest marks.

Winter Buying of Pipe

(*Continued from p. 861*)

commenced about April 15, we had on hand approximately 40,000 ft. of pipe. Many of our orders for water-main extensions are occasioned by the permanent improvement of the streets, and the purchase and delivery of pipe for such jobs must ordinarily await the receipt of the order from the Board of Public Works. Our weather conditions make it impracticable to lay water pipe during the winter, and in the few instances where we have distributed pipe several weeks in advance of the laying we have lost a few lengths of pipe and some boys have been injured by playing around the pipes.

Our experience in connection with the early delivery of pipe has been such that we make a practice of sending the pipe to the job a very few days in advance of the pipe laying crews.

W. C. HAWLEY
Chief Engineer, Pennsylvania Water Co., Wilkinsburg, Pa.

I believe that the plan of purchasing cast-iron pipe throughout the year can be partially, but only partially, adopted, and that it is to the interest of both the manufacturer and the purchaser that it should be adopted as far as possible. If the manufacturers will take the initiative and make it worth while for the purchaser to spread his orders over the entire year, they will find the purchaser willing to do so. In fact, it is already being done by some of the larger water companies and water departments.

In most cases plans for large supply mains are not made on short notice, and pipe for these mains could be ordered so that its manufacture and delivery could take place in winter. Most water-works systems are growing at a more or less steady rate, and it should be possible to estimate approximately the amount of pipe required each year. An order for that pipe could be placed so that it could be manufactured in winter. There will be, however, demands for extensions to distribution systems which cannot be anticipated, and orders for pipe for this purpose must be placed when the demand arises.

There are, however, some practical difficulties which will interfere with the delivery of pipe in winter. In the case of a supply line crossing tracts of land which have not been laid out in streets, there may be no objection to delivering the pipe along the route of the main, and leaving it there until it is laid during favorable weather. This cannot be done, however, through streets in built-up sections of a town or city; pipe for such locations must be stored. Not every water company or department has available storage room for large quantities of pipe. This difficulty, however, could be overcome, possibly, by having the pipe manufactured and stored at the foundry.

I believe that an offer to purchasers of a price differential would be an effective way of encouraging winter buying. Our company has for some years past placed an order each year about Jan. 1, for its estimated needs, and we have found the manufacturers willing to quote better prices for pipe which can be made in winter than that made at a later part of the year.

Inspection of Pipe

It sometimes happens that there is a demand for the laying of a pipe line which could not have been anticipated, and when an effort is made to buy the pipe it is found that delivery cannot be made for a considerable period of time, unless the purchaser is willing to take stock pipe—pipe which has not been inspected before it was coated. Some purchasers are willing to take such pipe, but many of those where the water pressure is high, or where the pipe is to be laid under pavement, have learned by experience that they cannot afford to take such a chance.

The solution of this difficulty, and one which would permit the manufacturer to make pipe during the winter, would be for the manufacturer to have the pipe inspected, when made, by a reputable inspector, not an employe of the foundry, and so be in a position to furnish pipe with the inspector's certificate. The cost of inspection should, of course, be added to the cost of the pipe, but the reduction of the cost of the pipe, due to more nearly continuous operation of the foundry, should more than offset this item. There is, however, against this proposition, the possibility that, if it were possible to purchase inspected pipe at any time during the summer, the purchaser might be less inclined to place an order for winter delivery. This could be taken care of, however, by a price differential.

Whether or not pipe can be laid in winter depends not only upon the latitude, but upon the weather conditions. In the vicinity of Pittsburgh it is sometimes possible to lay pipe during most of the winter. During some winters there will be from six to ten weeks when pipe cannot be laid economically. Many municipalities refuse to permit pavement to be taken up from Nov. 15 to March 1, and with some soils there is good reason for so doing, for pavement cannot be replaced satisfactorily during freezing weather.

On the whole, I believe that there is much which can be accomplished along the line which you have suggested if the manufacturers will take the initiative and show the purchaser that it is to his advantage to place his orders for pipe so that the pipe can be manufactured in cold weather.

Business Notes

A. T. DULFER has been appointed manager of the New York office of the American Mason Safety Tread Co., succeeding J. W. Stodd, resigned.

D. K. HUTCHCRAFT, formerly vice-president of the Indiana Air Pump Co., Indianapolis, and a specialist in air-lift pumping, has been appointed district manager of the Chicago Pneumatic Tool Co.'s branch office recently established at Tulsa, Okla.

H. H. ROBERTSON CO., Pittsburgh, manufacturer of asbestos-protected metal roofing, announces that Johns-Manville, Inc., New York, has been appointed joint selling agent for its product. In future asbestos-protected metal, recently named Robertson process metal, for roofing and siding, will be manufactured and shipped from the Robertson plant at Ambridge, Pa. In its manufacture Johns-Manville asbestos saturated felts will be used. This arrangement, it is pointed out, will afford to customers the advantages of both organizations, one in the manufacture of saturated asbestos felts and the other in the fabricating of the finished product.

Equipment and Materials

Wood Fiber Panels Produced as Lumber Substitute

As a substitute for lumber material in the form of panels designated as Tensil-ite has been developed by the J. P. Lewis Co., New York. The panels are made from hardwood fibers from which the sap, knots and shakes have been eliminated to prevent splitting or checking. The fibers are laid in layers to eliminate grain from the finished product and the laminations are cemented together and built up to thicknesses of from ½ to 1 in. by hydraulic pressure of 500 lb. per square inch. Stock sizes of the panels are ½, 7/16, ½, ⅝, and 1 in., with weights per 1,000 sq.ft. of 500 lb., 800 lb., 1,000 lb., 1,500 lb., and 2,000 lb.

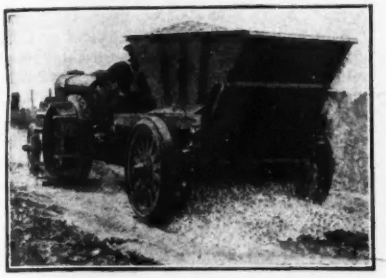
Among the advantages claimed for the material by its manufacturer are its wood-working qualities (it can be cut with a saw, planed, dovetailed, beveled and bored), its rigidity and structural strength. It is said to be adaptable to a wide variety of uses, including sheeting for concrete forms. Both Mr. Lewis, president of the company manufacturing Tensil-ite, and E. E. Whitney, its sales manager, were formerly connected with the manufac-

ture of Beaver board. At the present time the Tensil-ite panels are made only in 4 x 5-ft. sizes, but machinery is being installed to produce commercial building sizes from 8 ft. to 14 ft. long.

Hopper Body Trailer Designed for Road and Street Work

An all-steel hopper-body trailer with a rounded load capacity of 2 cu.yd., designed for use with a Fordson tractor, has just been put on the market by the Miami Trailer Co., Troy, Ohio. It is designed especially for use on road construction and maintenance for hauling crushed stone, sand, gravel, and other material, or for the transportation of aggregates to the concrete mixer. Other uses are in building and excavation work, earth haulage or removal of garbage and refuse in cities.

The hopper body has a rear bottom-



dump door on which the size of opening may be controlled either to dump the entire load or to spread the material to any depth desired. The load dumps behind the rear wheels. The equipment is mounted on Timken roller bearings and rubber tires and may be used with high speed trucks or tractors.

By means of a separate flared top box of ½ or 1-yd. extra capacity a load of greater volume than 2 cu.yd. and weighing 2½ tons may be transported. A special automatic hitch bolts onto the rear housing of the tractor. Both release and winding levers of the trailer are at the right hand of the tractor driver, so that the load may be dumped or spread without stopping.

The trailer weighs 1,960 lb. and is 65½ in. high. When desired the dump body may be removed, the drawbar lengthened and a platform type of body substituted.

All-Steel Aggregate Bins Deliver Measured Batches to Trucks

Among recent additions to the line of construction equipment manufactured by the Blaw-Knox Co., Pittsburgh, are two types of overhead steel bin with batch-measuring device for delivering sand and stone for concrete to trucks or industrial railway cars. The larger unit, named the "Batcherplant," is made in sizes to measure and store from 52 to 116 tons of material, while the smaller unit is essentially a charging bin holding only 6 cu.yd. The accompanying illustrations show the general features of both types.

The Batcherplant (Fig. 1) of all-steel construction consists of an overhead V-shaped hopper with curved bottom mounted on columns with clearance for the passage of a motor truck. Adjustable batch-measuring devices just below

FIG. 1. BATCHERPLANT WITH STORAGE CAPACITY

the hopper enable the contractor to proportion by volume the amount of sand and stone desired in his concrete mix. The mechanism of these batch-measurers allows the batch of predetermined volume to be dumped into trucks of all design, and with various arrangements of compartments, batch boxes and hopper cars. A feature of the mechanism is the strike-off gate which shuts off the flow of material from bin to batcher and at the same time strikes it off in accordance with specifications. These plants are built in standard units and may be used with either motor truck or industrial railway haulage.

The smaller type of bin shown in Fig. 2 is used principally for charging and not for storage. Each unit is furnished with a single batch-measuring

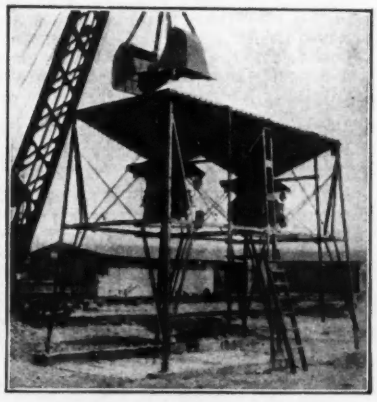


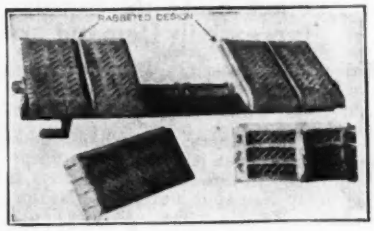
FIG. 2. DUPLEX CHARGING UNITS

device. Ordinarily contractors use two of these units, one for sand and one for stone, in a duplex arrangement, as illustrated.

Dumping Grate for Small Sizes of Anthracite

As an aid in the solution of the problem of burning under boilers the smaller sizes of anthracite, the McClave-Brooks Co., Scranton, Pa., has developed a new dumping grate with ¾-in. diagonal mesh, rabbeted sectional tops. Its general features are shown in the accompanying illustration. This grate is made in a variety of meshes so that coal sizes such as No. 1 buckwheat, No. 2 buckwheat, rice, barley, and even the finest anthracite screenings and culm may be burned.

To secure an overlap between the ends of the sectional tops, one end of



each is beveled. This feature prevents sifting of coal between the bars and takes care of expansion and contraction of the grate. The diagonal slots in the grate, the manufacturers claim, permit the most efficient distribution of air space. With the sectional tops it is not necessary, when a burnout occurs, to replace an entire grate bar as the damage can be repaired by the renewal of one or more of the small sectional tops.

Publications from the Construction Industry

Rolling Partitions—J. G. WILSON CORP., New York, is distributing illustrated folders on its rolling partitions for use in schools, churches and other buildings. These partitions are made of wood slats threaded on tempered steel bands and may be secured in either vertical or horizontal rolling types. In two other leaflets the company's hardware for glass door house partitions and automatic rolling fire doors are described.

Locomotive Shop Design—H. K. FERGUSON CO., Cleveland, in an illustrated four-page folder points out economies in the construction, operation and maintenance of transverse locomotive-erecting shops resulting from the substitution of its Gap-crane for the suspended type of crane ordinarily used. The Gap-crane involves the use of two steel girders placed far enough apart for clearance of a locomotive which, when raised, passes up between them. With this form of construction considerably less headroom is required in the shops than with the suspended type of crane, and savings up to 33⅓ per cent in costs of new shops are claimed by the use of this type of equipment. Due to the need of less overhead clearance it is possible also to place the crane runway at a lower level, resulting in shorter and narrower columns. The Gap-cranes are built for the FERGUSON company by the Morgan Engineering Co., Alliance, Ohio.

Power Shovels—THEW SHOVEL CO., Lorain, Ohio, is distributing a loose-leaf binder containing catalog sections covering its power-shovel equipment. There are separate bulletins on steam, gasoline, and electric shovels, continuous tread mounting, and lubrication. Additional sections for inclusion in the binder will be issued from time to time.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Lumber Showing Steady Increase in Demand

Labor, Not Materials, Principal Factor In Increased Building Costs, According To Manufacturers

"For the country as a whole, lumber has had at least its customary proportion of use in new building," states the Secretary-Manager of the National Lumber Manufacturers Association, in a recent survey of the building situation. "In many locations lumber construction has been particularly favored because of the relatively greater economy in cost.

"The accumulated housing shortage since 1916 up to the present year was equivalent to approximately two and a half full years of new building based on the 1910 to 1915 yearly average. At costs of construction prevailing last spring between five and six billion dollars expenditure would have caught up this building deficit.

"Building costs have increased considerably since last spring in many communities. The general building costs in Washington, D. C., for instance, are about 30 per cent higher than they were last fall and early last spring. This is largely due, however, to high labor costs inasmuch as the demand for skilled labor in the building trades has far exceeded the number of men available. Fifteen dollars a day has become quite customary in Washington for masons, bricklayers and plasters. The carpenters are getting somewhat less. In some building projects in New York as high as $30 a day has been paid for skilled labor.

"There is every reason to believe that the fundamental demand for building materials still maintains and that it will continue for several years, with of course ups and downs. There will be periods of great building activity alternating with periods of semi-stagnation until the building shortage is substantially caught up. These alterations will probably be due rather to the building trades labor situation than to building materials. There is little danger that the comparatively small increases in building costs, due to increases in the cost of building materials, will have much to do with discouraging or delaying building as long as the costs of building labor are so excessive and erratic.

"I look for continued strong basic demand for building materials for a considerable period of years and I believe that lumber will have its full share in the effects of that activity. In fact, the comparatively greater labor costs in installing other materials in buildings than in installing lumber is definitely encouraging the substitution of lumber construction in many large communities, wherever admitted under the ordinances. The National Lumber Manufacturers Association has taken advantage of this opportunity to press its activities on building code requirements to the end that lumber construction be not prohibited in those places where it can safely and economically be used."

Rapid-Fire Survey of Business Conditions

Steel production at 73 per cent capacity during last two weeks.

Plates in large quantities cost 2@ 2.15c. per lb., Pittsburgh mill, with a softer price rumored for the indefinite future.

Railroad steel ordered in the last ten months aggregates 4,500,000 tons, of which nearly 2,000,000 tons is for car building and repairs.

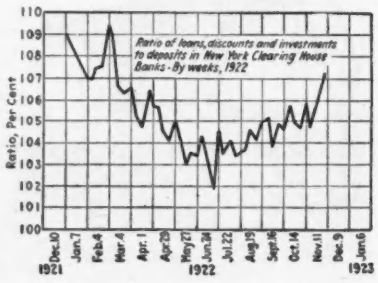
Money on both call and time loans ranged 5@6 per cent last week. The chart shows this year's range of the time loan rate.

Per capita wealth of the country increased 40c. during October, according to the Treasury Department. On Nov. 1 per capita money circulation was $41.44, against $41.04 on Oct. 1.

Business volume for the week ending Nov. 8 totaled $8,213,000,000, which was $1,480,000,000 under the preceding week, due to Election Day, as measured by debits to individual accounts.

Municipal bonds continue to hold interest of financial houses. Fourteen syndicates submitted bids on a $615,000 City of Syracuse loan on Nov. 9. Details of representative public bond sales are presented on the next page.

A new business index is submitted by Richard Hoadley Tingley in the *Annalist*, Nov. 13. It is the ratio between bank loans and bank deposits. He says: "Among all banks, national, State and private, trust companies and savings depositories, the ratio between loans and deposits should remain at approximately 100. This naturally follows since all money, except the negligible amount of what is termed till money plus such amounts as may be hoarded, finds its way, and this usually over the most direct route, into the deposit accounts of the banks. The loan which one man makes at his bank may be checked out by him to a score or more of creditors, thus reducing the deposit account in the very bank where the loan account has just been augmented, but the recipients of the proceeds of this loan quickly deposit their shares in their banks so that the deposit accounts of these banks are expanded without any compensating expansion of the loan account. No man has yet found it profitable to pay interest on a loan for the privilege of withdrawing the funds from circulation, and there is but one destination for circulating funds and that is the deposit account of a bank." The chart gives the business cycle of the present.



Foreign debt of the United States, per capita, was $209 in October.

Wholesale index numbers for October compiled by D. L. Bissell were as follows: Farm products, 130; orchard products, 161; food, 138; textiles and leather, 191; fuel and metals, 156; construction materials, 178; all commodities, 153.

Additional $40,000,000 capital will be voted on by Consolidated Gas Co. stockholders on Dec. 4 and 5, to discharge floating indebtedness.

Bond market was declining early this week. All Liberty loans dropped, while foreign bonds were notably weak. Low-priced rails and local traction bonds also lost.

Labor bank with a capitalization of $2,000,000 is planned for New York, according to William F. Kehoe, secretary of the Central Trades and Labor Council. This bank, to be known as the Federation Trust Co., is to be opened shortly after Jan. 1, and will be conducted along the lines of the Brotherhood of Locomotive Engineers Cooperative National Bank of Cleveland.

October Steel Ingot Output Highest Since 1920

A total of thirty companies, which produced 87½ per cent of the steel ingot output in 1921, have turned out 23,447,266 tons during the first ten months of the current year, according to the American Iron and Steel Institute. Operations in the steel mills throughout the country, are proceeding at about 75 per cent of capacity at the present time. The pig-iron output is also fairly high, running at an annual rate of about 32,000,000 tons.

MONTHLY PRODUCTION OF STEEL INGOTS

	Tons	
	1921	1922
January	2,203,186	1,593,482
February	1,749,477	1,745,022
March	1,570,978	2,370,751
April	1,213,958	2,444,513
May	1,265,850	2,711,141
June	1,003,406	2,634,477
July	803,376	2,487,104
August	1,138,071	2,214,582
September	1,174,740	2,373,779
October	1,616,810	2,872,415
November	1,660,001	.....
December	1,427,093	.....
Total	16,826,946	.....

In the face of increasing production, however, a shortage of cars has impeded shipments of material away from the mills, to the extent that products are now piled up at Pittsburgh, Youngstown, Birmingham and other production centers, beyond usual limitations.

(Concluded on p. 865)

Bond Sales for Ten Months Heaviest Since 1892

Sales of long-term municipal bonds during October aggregated $65,924,323 as against $96,449,885 for the preceding month and $65,911,016 for August, 1922, according to records kept by the *Commercial and Financial Chronicle.* A considerable contraction in sales is shown when the total for October is compared with $114,098,373, the value of disposals during the corresponding period in 1921.

Sales for the ten months ending Oct. 31, reached $975,285,288, a gain of 12 per cent over the same period last year and the heaviest total for any ten months since 1892.

Short-term securities aggregated $61,518,000, of which $59,128,000 was issued by New York City alone.

Among the more important issues were: Philadelphia, $12,000,000 4s at 100.147; Norfolk, Va., $2,000,000 5s at 103.41, a basis of about 4.55 per cent; Merced Irrigation Dist., Calif., $1,800,000 5½s at 102.92, a basis of about 5.28 per cent; Oregon, $1,500,000 4½s at 101.09, a basis of about 4.4 per cent and State of Mississippi, $1,000,000 4¾s at 100.155, a basis of about 4.65 per cent.

Of the thirty-seven representative issues shown in the accompanying table, ten sold at par, twenty-seven above and none below par; the yields ranging from 4.05 to 5.49 per cent. Rates varied from 4 to 6 per cent, with one issue in South Dakota at 7. The 4½s were all located in New England and the Middle Atlantic States, with the 4½s evenly distributed throughout the country, except the South. No 5s were issued in New England or the Southern States, but all those drawing 6 per cent were in the South and West, with the single 4 per cent issue in Massachusetts.

Steel Ingot Output

(Concluded from p. 864)

During the first ten months of 1921, the steel ingot output amounted to 13,739,852 tons, with the total for the entire year at 16,826,946. This tonnage is compared with 23,447,266 for the ten months of 1922, or an estimated total output of over 29,000,000 tons for the current year, at the rate of production existing, Oct. 31.

The steel ingot output has steadily increased since August, as shown in the accompanying table. September advanced 7 per cent above the August total and October exceeded the preceding month by 21 per cent, representing the highest tonnage for any month since October, 1920.

Unfilled steel tonnage on the books of the United States Steel Corporation, as of Oct. 31, totaled 6,902,287 tons, an increase of 210,680 over the preceding month. These unfilled orders represent the largest on hand for any month since February, 1921, at which time the total was 6,933,867 tons.

Car Loadings and Shortages Both Reach New High Records

Freight loadings for the week ending Oct. 28, reached the peak for any single week since 1920 and were .00¾ per cent less than the peak loading for any single week in the history of American railroads, according to the American Railway Association.

A total of 1,014,480 carloads of freight, all classes, were loaded during the week, as compared with 951,384 cars for the same period of 1921, and 981,242 during the corresponding week in 1920.

Car shortage on all roads in the United States, reached a new high record during the week ending Oct. 31, with 187,442 cars, an increase of 12,890 over the preceding week. Shortage of box cars alone touched 91,039, a gain of 9,305, while the coal car deficit totaled 47,273, an increase of 693 cars.

Not less than 3,716 surplus cars, however, are to be found throughout the seven railroad districts. These cars are of all kinds and in good repair.

Railroad buying of equipment continues; the Missouri Pacific, alone, having placed orders with the American Locomotive Works, at Schenectady, for fifty engines for December and January deliveries. The purchase of fifty more, of the heavy mountain type, is contemplated, in replacement of lighter equipment. The estimated value of the fifty heavier engines is placed at $3,000,000.

REPRESENTATIVE PUBLIC BOND SALES DURING OCTOBER, 1922

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Maturity	Dated	Purchased By
Oregon	Highway	$1,500,000	4½	101.09	4.40	1927–47	October, 1922	Security Trust & Savings Bank of Portland.
County								
Albany, N. Y.	Highway	138,000	4½	101.94	4.10	1923–42	Nov. 15, 1922	N. Y. State Nat. Bank
Allen, Ind.	Road	31,000	5	101.57	4.71	1924–33	Oct. 15, 1922	Dime Savings & Trust Co. of Ft. Wayne.
Boone, Ind.	Highway	5,000	5	100.64	4.86	1924–33	Oct. 3, 1922	J. F. Wild & Co. State Bank of Indianapolis.
Dubois, Ind.	Road	38,500	4½	100	4.50	1924–33	Nov. 15, 1922	Huntington Bank, Huntington, Ind.
Hancock, O.	Road improvement	10,000	5½	101.57	5.17	1924–31	Oct. 1, 1922	W. L. Slayton & Co. of Toledo
Jefferson, Ind.	Highway	13,600	5	100.03	4.99	1923–32	Oct. 3, 1922	Madison Safe Deposit & Trust Co. of Madison.
Mower, Minn.	Drainage	87,780	4½	100.40	4.73	1928–42	Nov. 1, 1922	Northwestern Trust Co. of St. Paul.
Shawnee, Kan.	Road	175,000	4½	100.60	....	.....	.....	Brown-Crummer Co. of Wichita.
Snyder, Pa.	Bridge / Road	50,000	4½	100	4.50	1924–43	Oct. 2, 1922	.....
Township								
Center, Columbiana Co., O.	Public road	37,000	5½	100	5.50	1923–26	Oct. 1, 1922	First Nat. Bank, Lisbon, O.
Fulton, Fulton Co., Ohio	Road improvement	6,100	6	100	6	.....	Nov. 1, 1922	Spitzer, Rorick & Co. of Toledo.
Jackson, Jackson Co., Ohio	Road improvement	66,500	6	100	6	.....	.....	Commercial Bank of Tiffin.
Municipality								
Ashton, S. D.	City improvement	17,000	6	101.61	....	Due serially	Nov. 1, 1922	Ballard & Co. of Minneapolis.
Barnesville, O.	Sewer	220,500	5½	106.10	....	1924–43	Sept. 1, 1922	Otis & Co. of Cleveland.
Boston, Mass.	City improvement	560,500	4	100	4.00	.....	Oct. 1, 1922	To Trust and Sinking Funds
Bristol, Va.	Street improvement	50,000	5½	101.07	....	.....	Sept. 29, 1922	Caldwell & Co. of Nashville and others
Central City, Neb.	Paving	108,500	5½	100.50	5.22	1923–38	Dec. 1, 1922	Omaha Trust Co.
Cold Springs, N. Y.	Waterworks	12,500	4½	100	4.25	1927–51	Nov. 1, 1922	Nat. Bank of Cold Springs.
Duluth, Minn.	School	75,000	4½	101.52	....	.....	Nov. 1, 1922	Hamilton A. Gill & Co., N. Y. C.
East Cleveland, O.	Street improvement	143,000	5	100.87	4.81	1923–32	Oct. 1, 1922	Guardian Savings & Trust Co. of Cleveland.
Everett, Mass.	School	18,000	4½	101.257	4.05	1923–41	Sept. 1, 1922	F. S. Moseley & Co., Boston.
	Macadam	10,000	4½	101.257	4.05	1923–27	Nov. 1, 1922	
	Sidewalk	34,000	4½	101.257	4.05	1923–27	Nov. 1, 1922	
Flint, Mich.	Paving	25,000	5	100	5	1923–26	Oct. 18, 1922	Industrial Savings Bank of Flint.
Fullerton, Cal.	City improvement	160,000	5	103.68	4.53	1923–42	Dec. 1, 1922	Blyth, Witter & Co.
Garfield Heights, Ohio	Street	9,044	6	103.27	5.40	1924–33	July 1, 1922	Milliken & York Co. of Cleveland.
	Drive	7,349	6	103.08	5.32	1923–32	Sept. 1, 1922	
Kingsport, Tenn.	Public improvement	20,000	6	106.17	5.49	1942	Oct. 17, 1922	Seasongood & Mayer of Cincinnati.
Lincoln Park, Mich.	Sewer	40,000	5	100.15	....	1952	Nov. 1, 1922	Matthew Finn.
	Water	30,000						
Mandan, N. D.	Park	9,000	6	102.50	....	.....	.....	.....
Merced, Cal.	Sewer	70,000	5	102.89	4.71	1923	Nov. 1, 1922	California Company.
Mt. Vernon, N. Y.	Sewer	15,000	4½	102.11	4.30	1935–37	Nov. 1, 1922	Lehman Bros., N. Y. C.
	Drainage	30,000	4½	102.18	4.29	1933–38	Nov. 1, 1922	Sherwood & Merrifield, N. Y. C.
	Highway	75,000	4½	100.34	4.42	1923–30	Nov. 1, 1922	Sherwood & Merrifield, N. Y. C.
Muskegon, Mich.	General improvement	50,000	4½	100.037	4.49	1923–32	Sept. 1, 1922	Harris Trust & Savings Bank of Chicago.
Newton, N. J.	Street improvement	20,000	5	163.228	4.61	1924–42	Aug. 1, 1922	Newton Trust Co.
Northampton, Mass.	Pavement	12,000	4½	100.171	4.20	1923–28	Nov. 1, 1922	R. M. Grant & Co. of Boston.
Port of Astoria, Ore.	Improvement	55,000	6	100.077	....	.....	Oct. 31, 1922	Freeman, Smith & Camp Co. of Portland.
Sand Spring, Okla.	Sewer extension	90,000	6	100	6	1947	Aug. 1, 1922	W. A. Brooks, Oklahoma City.
Wall, S. D.	Water	17,000	7	100	7.00	.....	Sept. 18, 1922	Security Savings Bank of Rapid City.
Woburn, Mass.	Water	11,900	4½	100.78	4.19	1923–27	Nov. 1, 1922	Old Colony Trust Co. of Boston.
	Macadam	33,500	4½	100.78	4.19	1923–27		
	Sidewalk	6,100	4½	100.78	4.19	1923–27		
	School	13,000	4½	100.78	4.19	1923–35		
	Sewer	23,700	4½	100.78	4.19	1923–45		

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 251 to 265, are the following:

Store and office building at Philadelphia, Pa., for Cunningham Piano Co., $1,000,000.

Shrine at St. Louis, Mo., for York Rite Temple Association, $3,000,000.

Theatre and office building at Philadelphia, Pa., for Stanley Co. of America, $2,000,000.

U. S. Levies Duty on Cement From Canada

The Treasury Department is preparing instruction to collectors of customs to collect a duty of 8 cents per 100 pounds on Roman, Portland and other hydraulic cement from Canada. Cement is on the free list of the new tariff act but with a proviso imposing a retaliatory duty equal to the duty imposed by any country on cement from the United States.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 251 to 265, are the following large projects:

Hotel at Chicago, Ill., to Paschen Bros., 111 W. Washington St., $2,250,000.

Office building at Chicago, Ill., to H. Erickson, 139 North Clark St., $1,000,000.

Passenger liner at Seattle, Wash., to Todd Dry Dock and Construction Co., Hylebos Waterway, Tacoma, $1,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 2; the next, on December 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.14	$3.95	+$4.40	$3.02½	$3.15	$3.85	+$3.30	$3.80	$3.75
Structural rivets, 100 lb	3.85	4.60	6.00	3.75	4.00	4.80	4.50	5.00	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.04	3.85	4 00	2.92½	3.05	3.85	+3.30	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	61.15%	45%	59½%	57-5%	41%	39.2@51.8%	40%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	50.00	51.50	48.70	55.50	63.00	54.00	53.00	55.00
Concreting Material:									
Cement without bags, bbl	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd	2.00	2.00	+2.52	2.25	1.75	1.90	2.25	1.00	1.50
Sand, cu.yd	1.00	1.35	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.10	1.65	2.25	2.25	3.50	2.25	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	59.00	42.00	40.00	51.00	+41.00	39.75	35.00	22.00	50.00
Lime, finishing, hydrated, ton	16.80@17.17	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	16.90@19.10	12.00	9.9C	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.0796	.065	....	.11	.08
Hollow partition tile 4x12x12, per block	.1230	.0776	.115	.0808	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	.93	.97	1.07	.95	1.00	1.08	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.....	.....	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

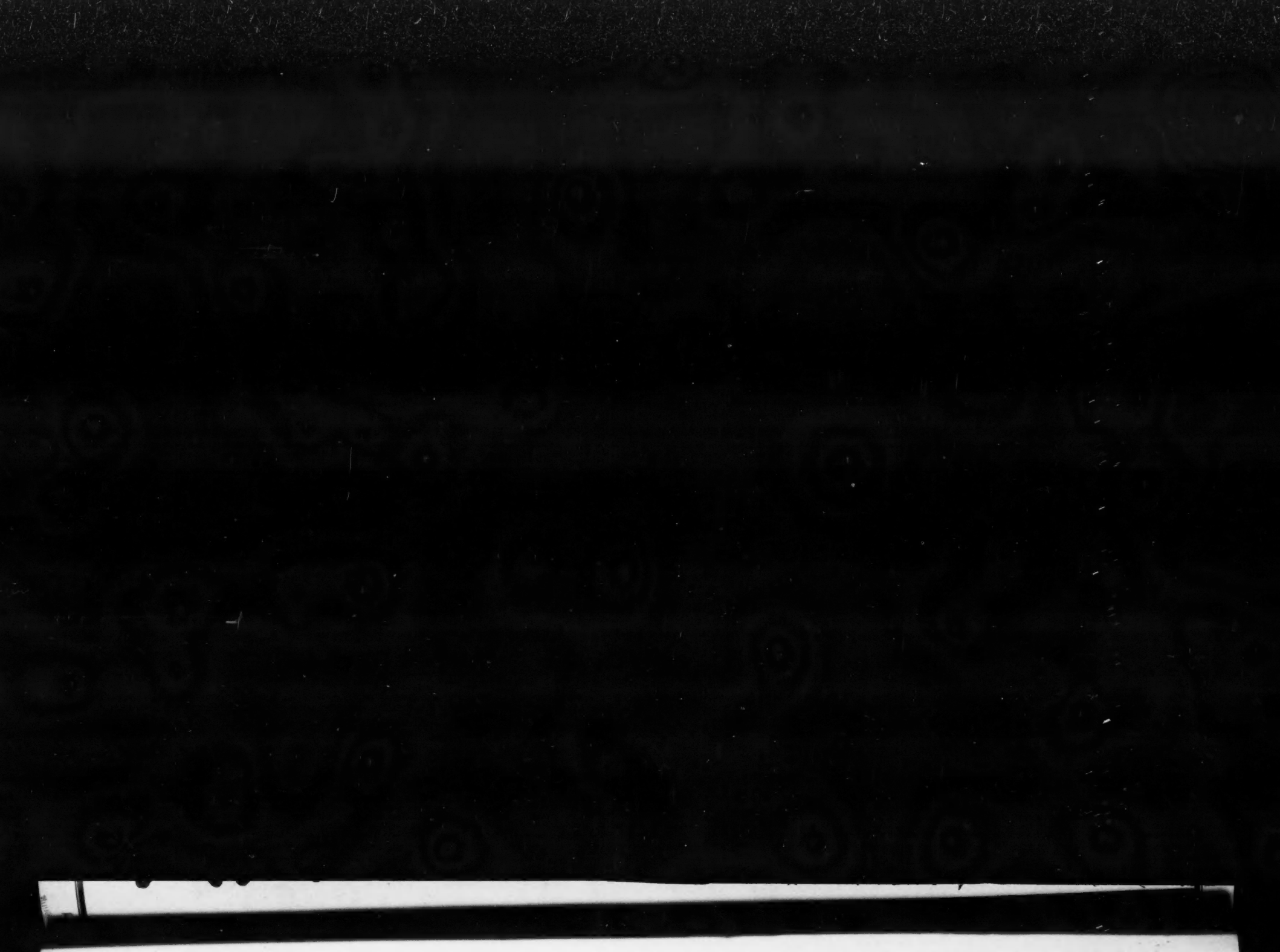
Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 1.00¼.) Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Mill price of steel shapes and reinforcing bars firm at $2 per 100 lb. on ordinary tonnages. This quotation, however, is subject to shading of $1@$2 per ton on large inquiries. Some of the more attractive orders on structural shapes, have been taken as low as $1.90, but special or undesirable plate business is quoted as high as $2.10@$2.15. Warehouse prices in the principal cities are fairly firm. Dallas, however, reports advance of 20c. on shapes and San Francisco, 30c. per 100 lb. on bars, during week.

Dallas quotes $2.52 on ¾-in. gravel as against $2.25 per cu. yd., following price rise, due to freight difficulties, in New York, Chicago and Denver.

Lumber prices generally firm. Minneapolis, however, quotes advance of $1.25 per M. ft. on Douglas fir. Lumber production in 394 mills reporting to the National Lumber Manufacturers' Association, for the week ending Nov. 4, fell off about 5 per cent; with a drop of 7 per cent in shipments, due to car shortage. Orders increased 3 per cent in volume during the week, leaving the status of the industry a little over 1 per cent below normal as to output; with orders 20 per cent and shipments nearly 30 per cent below normal.

Industrial conditions throughout the country are steadily improving but not without danger of labor shortage. New York building laborers' unions, however, have been involved in serious controversies for several months. Bricklayers and other mechanics, affiliated with the American Federation of Labor, have refused to use materials handled by members of independent laborers' unions. A proposal on the part of the New York Building Trades Employers' Association, to maintain the present wage scale but to permit individual agreements between unions and contractors, was rejected by the New York Building Trades Council, representing union building trades mechanics. Although these disagreements are a menace to building operations, nothing definite has transpired up to the present time.